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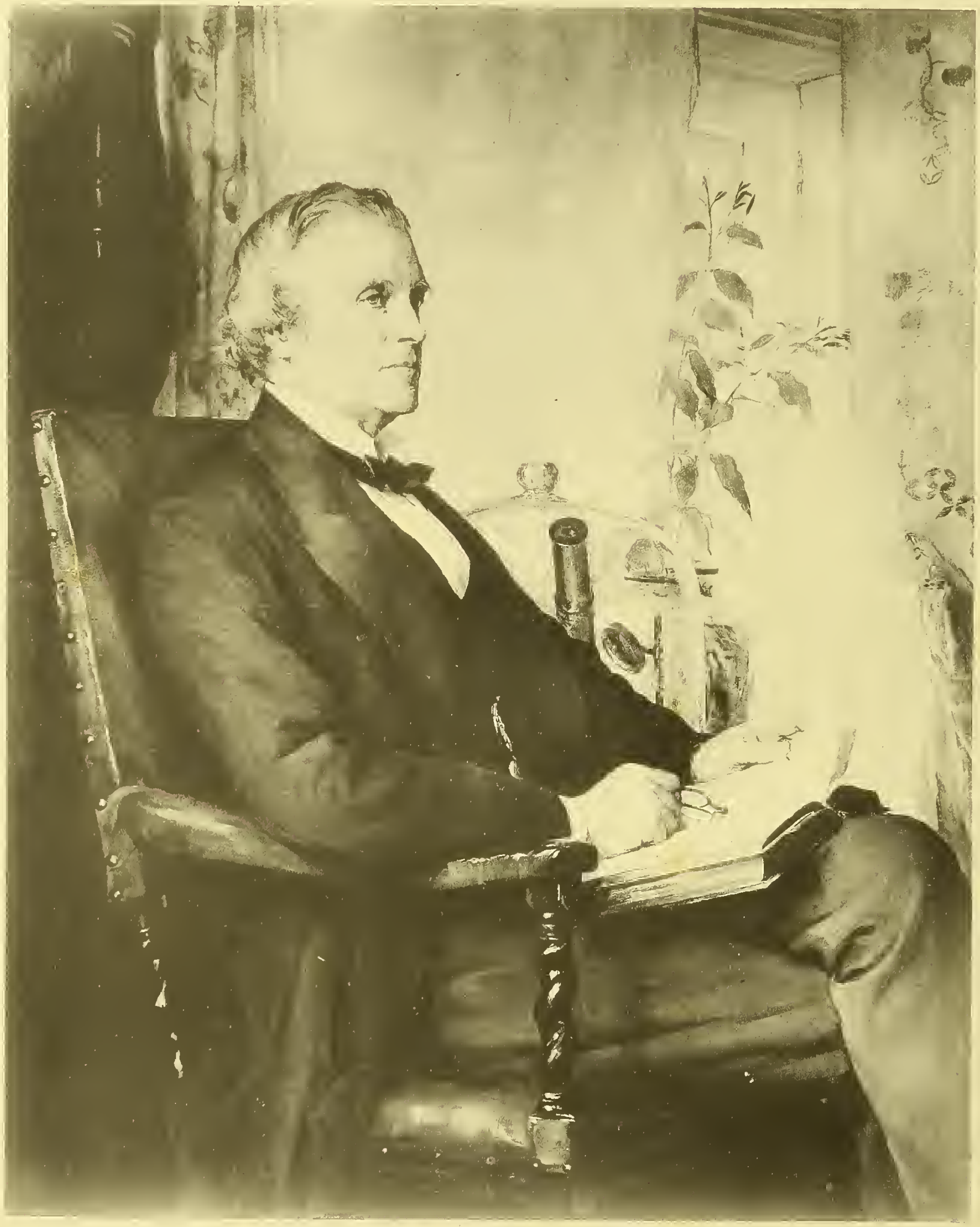

WILLIAM BOWMAN, æt. 73.

From a Photograph by Henry Dixon & Son, 112, *Albany Street, of the Painting by W. W. Ouless, R.A.*
Exhibited at the Royal Academy, 1889.

THE COLLECTED PAPERS

OF

SIR W. BOWMAN, BART., F.R.S.

Edited for the Committee of the "Bowman Testimonial Fund"

BY

J. BURDON-SANDERSON, M.D., F.R.S.,

AND

J. W. HULKE, F.R.S.

IN TWO VOLUMES.

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GENERAL PREFACE.

The Bowman Testimonial Fund was inaugurated in July, 1888, at a meeting held at Sir George Johnson's house. Its design was to make to Sir William Bowman some acknowledgment of the appreciation in which he was held on account of his high character and professional and scientific attainments.

This, it was suggested, should take the form of a portrait of himself, and also, possibly, a reprint of his publications.

His acceptance of this proposal having been asked and received by a deputation consisting of Sir George Johnson, Mr. J. W. Hulke, and Professor Burdon-Sanderson, a Provisional Committee was constituted by whose invitation the subjoined list of the Committee of the Bowman Testimonial Fund, consisting of 446 members, was formed.

It was thought more advantageous that the practical carrying out of the scheme should be relegated to a small sub-committee, which was accordingly forthwith appointed. It consists of Mr. Power and Professor Klein, with Sir George Johnson as treasurer, and Messrs. Brailey and Jessop as secretaries. The services of Mr. Ouless, R.A., were secured for the portrait, which was duly exhibited to subscribers in 1889 in the Library of King's College, London, and afterwards at the Royal Academy in the summer of the same year.

By the generosity of Lady Bowman each subscriber has received an engraving of the portrait, executed by Mr. J. Cother Webb.

The publication of the present volumes completes the task of the Committee. Their interest and value have been added to by the active interest taken in them by Sir William Bowman till nearly the very day of his death. Every proof sheet has been revised by his own hand and frequent notes appended.

The Committee believe that these volumes will furnish a most valuable contribution to the modern history of Science, especially in the departments of Physiology and Ophthalmology. They have to congratulate the subscribers on the acquisition of Professor Burdon-Sanderson and Mr. Hulke as editors.

The accounts were audited on December 11th, 1890, by Professor Michael Foster, F.R.S.

After the payment of all expenses of the portrait a balance of one hundred and ninety-eight pounds remains, which has been utilised in diminishing the cost of the present volumes to subscribers.

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W. H. Jessop, F.R.C.S.

PREFATORY MEMOIR.

The accompanying volumes contain the literary and scientific works of Sir William Bowman. At a period of life when most men are only beginning to apply their powers of observation and reflection, he, exercising both in a high degree, had already done work quite unexampled for its novelty, interest, variety, and above all for its accuracy. Before attaining the age of twenty-six he had won for himself a leading position amongst the most eminent anatomists of his time as a microscopist of first-rate ability, and the discoveries he then made, with the conclusions he drew from them, have ever since exercised an important influence in practical medicine, and have served as models for all subsequent and similar investigations. Later in life he became distinguished as an original investigator in physiology, and as a teacher of that subject, and at a still later period, devoting himself to a special branch of his profession, he stepped naturally and easily into the position of leader and representative of ophthalmic medicine and surgery, holding the same position in this country, though for a far longer period, that was occupied in Germany by his friend von Graefe, and in Holland by his still more intimate associate Donders.

It has been considered a right and fitting tribute to his memory to republish his writings in a collected form in order that they may be accessible to all those who take an interest in the history of medicine, since they really constitute the starting point of all recent work on the subjects with which they deal. It is to be hoped that the student who now or in after years may find time to read these memoirs may be led to feel that there is always abundant material at hand which will well repay intelligently directed observation, whilst he may rest assured that nothing would have given their author greater pleasure than that his own work, retold, had led a younger generation to more profound and careful investigation of nature and to knowledge more precise and certain than that to which he had himself attained.

From the numerous enquiries he recently made from his still surviving school-fellows and their relatives, and from the interest he took in preserving all reminiscences and memorials of his school life, it would appear that he intended to write an autobiography in his retired leisure, and it can only be a matter of regret that his intention was never fulfilled. The principal events of his life are here briefly given and naturally arrange themselves under the several periods of his school days, his association with King's College and its Hospital, when most of his early scientific work was accomplished, and lastly, with the Royal London Ophthalmic Hospital, Moorfields, where his opportunities for studying the diseases of the eye were practically unlimited, and where he obtained the knowledge and experience that supplied the materials for his valuable contributions to ophthalmic science. In accordance with this, his literary and scientific work can broadly be divided into early histological writings, his essays on general surgery, and finally, his papers and memoirs on ophthalmic subjects.

WILLIAM BOWMAN was the son of Mr. JOHN EDDOWES BOWMAN, a banker, and was born on July 20th, 1816, at Nantwich. He died on the 29th March, 1892, from pneumonia, at his country house, Joldwynds, near Dorking, in Surrey, at the age of 76, and lies in the northern slope of the pretty churchyard surrounding the church, built by Mr. GEORGE EDMUND STREET in memory of his wife, at Holmbury St. Mary. BOWMAN, with two brothers, was educated at Hazelwood School, near Birmingham, which was at that time kept by Mr. THOMAS WRIGHT HILL and his four sons, one of whom still lives, whilst another was well known in after years as the principal agent in establishing the penny post—Sir ROWLAND HILL. Mr. HILL was a highly intelligent but eccentric man, and took great pains in instructing his pupils. BOWMAN joined the school at the age of 10, and a report is still extant, written by Mr. Hill apparently for his own guidance, showing in a very exceptional manner the attainments and capabilities of the lad. Amongst other good plans and improvements in education, Mr. Hill adopted the system of monitors with the best effect on his pupils, and a magazine was started, the setting up of the type and the printing being entrusted to the boys. In the fifth volume many of the sheets and articles are signed by Bowman as printer, and his name, as well as that of Montague Villiers, subsequently Bishop of Carlisle, is mentioned as the recipient of several prizes. Even at this early period he was deft of finger, and there still exists in the library of a schoolfellow, now a well-known citizen of Birmingham, Mr. Osler, a card-board model of the school buildings made in their spare hours by the two boys. He seems to have inherited habits of accurate observation from both parents, for his mother was a good draughtswoman and painter of flowers, and could copy in woolwork a flower from nature, whilst his father was a botanist and geologist of more than ordinary attainments in the days when Robert Brown and Smith were developing those subjects. He left Mr. Hill's school at about the age of sixteen, and was apprenticed to Mr. Joseph Hodgson, a member of the Society of Friends and a highly philosophical surgeon, whose skill was at that time well known in the midland counties. It is said that his desire to enter the medical profession was immediately due to the interest he took in the treatment of a wound of the hand he had accidentally inflicted on himself in the laboratory whilst experimenting with gunpowder. At this period only three years' study were required by the College of Surgeons, the first two of which were directed to be mainly spent in the study of anatomy and physiology. To these subjects he accordingly devoted himself with much earnestness, and the knowledge of them he then acquired stood him in good stead in after years. But even at this time he appears to have felt what he well expressed in an introductory lecture delivered twenty years after at King's College—that if a practical knowledge of anatomy is desirable for the student, the practical knowledge of disease and its treatment, which the wards of a hospital supply, are far more important, still more indispensably necessary to him. He worked unceasingly in the wards and in the post-mortem room, and, from his practice at school, undismayed at the act of placing his ideas upon paper and committing it to the printer, he wrote a monograph on influenza, as well as other papers, which, however, being necessarily crude and immature, he did not think it desirable to publish. Yet, in looking over one of them, shortly before his death, he remarked to a member of his family that he was surprised to find how much he then knew, and how he could hardly have expressed himself better with his maturer knowledge. The only fragment that remains of this date are some cases in 'Ryland's Diseases of the Larynx,' to which work he contributed four coloured plates. The drawings reproduced in these volumes are well executed, and would prove creditable to any book on the subject published in the present day. At this time he appears to have made a series of measurements of the several orifices of the heart at the instigation of Dr. Blakiston, who, to show his appreciation of this and some of his later work, subsequently presented him with a fine microscope, by Powell, which remains in beautiful order, and is preserved with religious care to the present day.

He came to London in 1837, and in October of that year joined the medical department of King's College as an advanced student from Birmingham, working under John Simon, who was then beginning his own fifth year of studentship and had just been made Prosector to Todd for the physiological lectures. In the following year, 1838, Simon became Demonstrator of Anatomy conjointly with, and second to, F. T. Macdougall, whose after career as Bishop of Labuan was so distinguished, and Bowman succeeded Simon in the physiological Prosectorship, and thus commenced the intimate association with Todd which had so great an influence on his subsequent life. In the course of this year he visited the hospitals of Holland, Germany, Vienna, and Paris.

In October, 1839, Macdougall having left King's College for Oxford, Simon became Senior Demonstrator of Anatomy, and Bowman was appointed Junior, being made at the same time Curator of the Museum.

In 1840 he passed his examination at the Royal College of Surgeons, and in 1844 was elected Fellow. At this period King's College Hospital had just been founded, and a brief notice appears in the "Lancet," of Feb. 29th, 1840, stating that Dr. Budd, of the *Dreadnought*, had been appointed Professor of Medicine and Physician to the Hospital, and Mr. Fergusson, Professor of Surgery and Surgeon. Simon and Bowman were at the same time, or shortly afterwards, appointed Assistant Surgeons to the Hospital, Simon in particular being associated with Fergusson, and Bowman with Partridge, who was the Professor of Anatomy and Second Surgeon. The colleagueship and intimate daily association of Simon and Bowman continued until Simon removed to St. Thomas' Hospital, and Bowman became Senior Assistant Surgeon. A few years later the pressure of private practice compelled him to give up his appointment at the hospital. He did not, however, relinquish all connection with the College, for at the time of his death, Sir William Bowman was still an active Member of the Council and was Chairman of the Medical Committee.

His relations with the Royal London Ophthalmic Hospital, Moorfields, were that he was appointed Assistant Surgeon in 1846, and in 1851 became full Surgeon, retiring by reason of his age in 1876.

In 1842 he married Miss Harriet Paget, and Lady Bowman still survives him. His family numbered seven, and the title has descended to his eldest son, Sir William Paget Bowman.

On first coming to London, Bowman lodged in Norfolk Street, Strand, and then in Craven Street. He subsequently moved to the late Dr. Robert Lee's house in Golden Square, and then, in 1850, to 5, Clifford Street, the house in which Liston lived and died. From 1857 to 1871 he had a house at North End, in Hampstead, which, as he was an early riser, enabled him to enjoy his favourite pursuit of gardening, leaving for town a little before nine in the morning, whilst it had the additional advantage of permitting him to breathe pure air, instead of entering into society, where he would have always been a welcome visitor, but to the late hours of which he was unsuited.

The scientific and literary work accomplished by Bowman during the three years, 1839–42, included his original investigations on "The Structure of Striated Muscle," read before the Royal Society in 1840–41; on "The Structure of the Mucous Membrane of the Alimentary Canal," which appeared in Todd's 'Cyclopædia of Anatomy and Physiology'; and on "The Structure of the Kidney," which was read before the Royal Society, June, 1842.

In the year 1839 Dr. Todd commenced the publication of the 'Cyclopædia of Anatomy and Physiology,' the largest and most important work of the kind that has appeared in England, and still valuable for the number and variety of the original articles contributed by men of the highest standing. It was natural that Dr. Todd should engage the services of one who had already shown that he was a first-rate microscopist, and who was a member of the staff of his own hospital. Accordingly we find that Bowman was early engaged as a writer, his name appearing for the first time as a contributor in the third volume. The several articles "Mucous Membrane," "Muscle," "Muscular Motion," and "Pacinian Bodies" were from his pen. These were, however, the only articles he wrote for the 'Cyclopædia,' as he probably then became fully occupied with the preparation of the 'Physiological Anatomy and Physiology of Man.' The article on "Mucous Membrane" is for the time at which it was written exhaustive, and this piece of work was the more creditable because microscopic research was then in its infancy. The soft texture of the mucous membranes renders them exceedingly difficult to examine, and the means of hardening, cutting and mounting sections which are now common and have so materially aided investigators in this subject, were then almost limited to maceration in alcohol and in solutions of a few salts of various degrees of strength.

The appearance of the 'Physiological Anatomy and Physiology of Man,' which Bowman wrote in conjunction with Todd, the first part of which appeared in February, 1843, and the fourth and last, in 1856, constituted an epoch in physiology. It was the first physiological work in which histology—the accurate description of the structure of the various organs and tissues as displayed by the microscope—was given. It was written in a singularly lucid and interesting style, and its immense superiority in microscopical detail may be appreciated by contrasting it with other similar treatises published about the same time, such, for example, as those of Bostock, Elliotson, and Carpenter.

The work is well illustrated throughout, and whilst some of the woodcuts are copies from other works, a very large number are to be assigned to the authors, the greater part, both of the sections and of the woodcuts, being made by Bowman; and so steady and true was his hand, that many of his drawings were made directly on the wood, without the intervention of an artist. The authors acknowledge in the preface to the second volume their indebtedness to Dr. Lionel Beale for drawing up the concluding chapters of the work, and to Dr. Hyde Salter for some of the illustrations.

In 1840, he wrote the article "Surgery" in 'The Encyclopædia Metropolitana,' a succinct but good account of the state of that subject at the time, dealing chiefly with the diseases and injuries of the bones and arteries, wounds, burns, hernia, and diseases of the eye.

As the immediate result of his histological work on muscle, he was elected a Fellow of the Royal Society, being admitted in 1841 at the unusually early age of twenty-five; and, in the following year, in recognition of his merit in the same line of research on the kidney, he was awarded the Royal Medal of the Royal Society.

The manner in which he fulfilled his duties as a teacher of anatomy and physiology appears to have been in all respects admirable. He was regular in his attendance, both in the dissecting rooms and in the lecture theatre. Thoroughly cognisant of the value of the microscope, he naturally endeavoured to induce the students in the College to cultivate it and familiarise themselves with its use. In those days the microscopes made in England by reliable opticians were very expensive, and to overcome this difficulty he brought over good and far cheaper instruments from Paris. His lectures were well attended. One of his pupils, in a letter giving an appreciative estimate of his style, remarks that in his day nearly the whole staff—BUDD, PARTRIDGE, FARR, FORBES, and RYMER-JONES, were excellent lecturers in their several ways, and that, although BOWMAN was by no means so brilliant a lecturer as either BUDD or TODD, his want of animation was compensated by his earnest manner and remarkably clear enunciation. He evidently took a deep interest in his work as a teacher, and though far less fascinating than TODD, was more impressive. His delivery was slow, in consequence of his wish to enable students to take full notes of his lectures, a point upon which he always strongly insisted. He appeared to be really fond of teaching, and was always glad to remain in the theatre after his lecture was finished, to explain any difficulty that might have arisen in the minds of the students on the subject under consideration, by whom much information could thus be picked up, whilst his power of expressing in words the thoughts passing through his brain, was a marked feature in his success as a teacher.

Turning now to his ophthalmic work, his first important communication was a paper read at the Oxford meeting of the British Association in 1847. This has become classical from the novelty and value of the facts recorded. It was entitled "On Some Points in the Anatomy of the Eye, chiefly in reference to the Power of Adjustment." In this paper he demonstrated simultaneously with, and independently of, BRUECKE, the structure and function of the ciliary muscle, and it constituted the subject of the lectures he delivered at Moorfields Hospital.

In the year 1851 the ophthalmoscope was devised by HELMHOLTZ, an instrument which has revolutionised the diagnosis and treatment of the diseases of the eye, and BOWMAN was immediately and profoundly interested in it. He was one of the first to become expert in its use, and we can imagine the animated discussions that would arise when VON GRAEFE and DONDERS, who met for the first time at Moorfields, in the summer of this year, compared their experience with his. These remarkable men had been attracted to England by the Great Exhibition, and a warm and disinterested friendship sprang up between them and BOWMAN, which was broken by the death of VON GRAEFE in 1870, whilst DONDERS survived till 1889. It will be long before the world will see three such men, all possessing unusual ability and exceptional attainments, all intensely earnest in their work, and all glowing with the interest that is excited by the discovery of a new and unexplored country, meet together in such amity and brotherly love.

The discovery by von Graefe that iridectomy was an effective remedy for acute glaucoma was published in the course of the year 1857, and materially modified the treatment of that obscure disease. The method was tried by Bowman, with his accustomed earnestness. He found it effective, and immediately and strongly advocated it. He translated the article "On Glaucoma and the Results of Iridectomy," written by A. von Graefe, in the eighth volume of the 'Archiv. für Ophthalmologie' and appended notes, in one of which he particularly discusses the occurrence of sympathetic ophthalmia as the result of iridectomy performed on one eye, and in another advocates what is now the almost universal practice of making the section upwards on the ground of preserving the natural appearance of the eye for optical reasons, and as aiding in the prevention of cystoid cicatrices the formation of which he carefully describes. The operation has been the means of saving vision in many eyes that would have been otherwise lost, and the translation appeared in the 'Reports of the Royal London Ophthalmic Hospital.'

In 1864 he gave in the 'Moorfields Reports' the results of his observations continued for more than a year on needle operations in cases of detached retina, his object being to open a permanent communication between the effused fluid in the subretinal space and the vitreous, thus preventing its further spread between the retina and choroid. He states himself that he was not more surprised than delighted when a positive and sometimes a considerable amelioration of sight took place even in those parts of the field corresponding unequivocally to detached portions of the retina. In the following year, 1865, the method of removing cataract by means of a spoon attracted the attention both of Bowman and of Critchett, both of whom contributed papers on the subject to the 'Reports.' That of Bowman is long, and is an excellent example of the minute care he bestowed on every step and detail of the operation.

Other short but valuable communications on ophthalmic subjects to the 'Reports of the Royal London Ophthalmic Hospital,' viz., those on "The Treatment of Lachrymal Structure," and "The Division of the Canaliculus for the Relief of Epiphora;" on "The Use of Two Needles at Once in Capsular Cataract," and on "The Operation for Conical Cornea" are all well known to ophthalmic surgeons.

When the Ophthalmological Society of the United Kingdom was founded in 1880, Bowman took the warmest interest in its success, and his position, age, and knowledge made it natural that he should be invited to become the first President. He willingly accepted the office, retaining it for three years. His introductory address was simple and earnest, and he continued to the close of his life to support it by liberal donations to its funds. He was delighted to see a numerous band of a younger generation devoting themselves to the earnest study of the diseases of the eye, and by exciting mutual interest and by the exhibition and record of cases that would otherwise have been lost, developing and rendering more accurate and successful both diagnosis and treatment.

The natural bent of his mind was towards pathology and operative surgery and to classical work. He may, perhaps, have felt that he suffered from competition with so brilliant an operator as Prof. Fergusson, for it was reluctantly and, as it were, compulsorily that he became a specialist. When patients presented themselves at King's College Hospital, and asked for the "oculist," he declined the appellation, saying he was a surgeon; but, partly owing to his success in the treatment of the affections of the eye, and partly owing to the circumstance that after Dalrymple's death the heads of the profession, represented by Sir James Clark, Todd, and Liston, strongly supported him, the tide of ophthalmic practice became too strong to be resisted, and he gave himself up to it. His careful and prolonged work with the microscope was an excellent introduction to the delicate manipulations required for the successful prosecution of ophthalmic surgery, and it was soon generally recognised that he possessed extraordinary skill, both in the diagnosis and in the operative treatment of the diseases of the eye.

Of the mature life of a surgeon in active practice in a great city there is little to be said. In his case, rising early in summer, he arrived in town from Hampstead at nine or a little later, attended to Hospital work, King's College or Moorfields, as the case might be, was engaged with patients till late in the afternoon, yet could still find time for council or other meetings of societies that required his presence—and he belonged to many—and returned to the quiet enjoyment of his tranquil home, surrounded by a few choice books and works of art, and a family devoted to his happiness. In winter, living more in town, he attended sedulously the meetings of the Royal Society and those of the Royal Institution, of which he was for some time the honorary secretary, organising the lectures and taking a deep interest in the promotion of its objects.

The want of good nursing in King's College Hospital led to the establishment by Todd, Bowman, and others, of St. John's House and Sisterhood, an institution which, by providing trained nurses for the sick and poor, was the first to set on foot the present system of hospital and private nursing, a work of which only those who can remember the system as it was, can recognise the full significance and value. In this connection he was able, a few years later, to aid Miss Nightingale by sending out trained nurses to the East at the time of the Crimean War, and he was a member of the Council of the Nightingale Fund until his death.

In consultation he was gentle, patient, and thoughtful; alive to, and quickly seizing, the salient points of every case; very reserved, giving his opinion in a few words, but decisively, both as to forecast and treatment.

A gentleman well qualified to judge, who had visited at different times many surgeons at home and abroad for sub-acute glaucoma, said of him that his touch was the "lightest and yet the most enquiring" of all those under whose care he had placed himself. Another who knew him well said of him that one of his most striking characteristics was the power he possessed of concentrating his thoughts for the time on the one subject he was investigating. When iridectomy and tension of the eye engaged his attention, he thought of nothing else, and so with conical cornea and detachment of the retina. He never had more than one subject in his mind at one time, but he worked that one thoroughly out; and so with his patients. Though delicate and fragile both in form and feature, an appearance well rendered in the portraits affixed to these volumes, he was able to endure much work, and rarely suffered from any disturbance of health with the exception of occasional headaches, and in later years slight attacks of sciatica. Without being an ascetic, he was abstemious in his habits, eating little and drinking less. He was an early riser and a non-smoker.

He had a clear idea of the relative value of the different branches of knowledge associated with medicine, and recognised the futility of any endeavour on the part of the student to make himself a profound chemist, botanist, or physiologist, believing that such an attempt necessarily leads to the neglect of the practical subjects which are the occasion for which these foundation sciences are studied. No one knew better than he that "ex libris nemo evasit artifex," the scene of the labours of the student, was, in his opinion, at the bedside of the patient. He strongly recommended the cultivation of the habit of thinking, and carried into practice what he taught. From the beginning to the end of his life he held his profession in high esteem, and believed that to excel in it was worthy of enduring effort.

He was an excellent man of business, and made a good chairman, possessing great weight, and a quite exceptional power of swaying the opinions of men to his own way of thinking. His support was, therefore, of great importance to those who were candidates for any office, and in effecting changes in the organisation of the institutions to which he belonged.

One of his last, if not his last, written utterance is to be found in the graceful tribute he paid to Donders in an obituary published in the "Proceedings of the Royal Society" in the course of 1891. The language in which he spoke of his friend might well be applied to himself when he said that he was doubly fortunate; for while he bore a conspicuous part in the extension of knowledge and its beneficent application in fields which he found already ripening for the discoveries with which his fame will be ever associated, he lived long enough to see the rich results of his labours universally and gratefully acknowledged by his contemporaries.

HENRY POWER.

VOLUME II.

MISCELLANEOUS, SURGICAL, AND OPHTHALMOLOGICAL PAPERS.

By SIR WILLIAM BOWMAN, Bart., F.R.S.

EDITED BY

Mr. J. W. HULKE, F.R.S.

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PREFACE.

This volume, the preparation of which I was asked to undertake by the "Bowman Testimonial Committee," comprises a selection of "Reprints," together with some papers now first printed—Miscellaneous, Surgical, and Ophthalmological. These, selected from a large amount of material, and arranged with the assistance of the Author, are textually reproduced without alteration. Read from the standpoint of the time when each was written, these memoirs, in addition to their intrinsic merits, have, as marking the views and opinions then prevalent, a distinct value for the student interested in the history of modern medicine. In some instances, whilst the papers were passing through the press, the Author has added short explanatory notes, by which their value has been increased. Much help has been rendered me by the Honorary Secretaries to the Committee, Dr. Brailey and Mr. W. H. Jessop, for which I here offer them my warm thanks.

J. W. HULKE.

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REPRINTS, MISCELLANEOUS, SURGICAL, AND OPHTHALMOLOGICAL.

I.

NOTE ON INFLUENZA, AS IT OCCURRED IN BIRMINGHAM, IN 1833.

This disease began to make its appearance in Birmingham during the last days of April, 1833. In the early part of its visit the cases were very numerous, and, in the generality of instances, comparatively slight, but as the number decreased they became more serious and often fatal, the disorder attacking principally those of weak habit, or of worn-out constitution, drunkards, and such as had previously suffered from pulmonary disease, more particularly bronchitis.

In many of the class of cases first alluded to, and which may be considered to present most clearly the characteristics of the disorder, because unobscured by other affections, the primary symptoms were pains in the neck, back, and limbs, total loss of appetite, and white furred tongue, a peculiar sense of constriction about the forehead, and frontal headache, running from the nose, and sore throat, though with little perceptible local appearance of inflammation, a hot, dry skin, costiveness, and a quickened pulse. A striking feature was a remarkable depression of spirits, associated with great debility and prostration of strength, which continued for many days. In some instances all the above symptoms were present within the first days of the attack, but frequently one or other of them was absent. In some cases sore throat was absent; in a smaller number there were not any pains in the limbs; but all attacked by the disorder were greatly depressed, and had headache, with more or less fever. The trachea and bronchi frequently became involved during the second or third day. In the milder cases a dose of calomel and antimony at bedtime, followed by a purge on the next morning, with saline medicines, generally sufficed to check the disorder within three or four days, but in not a few instances when the patient was pleasing himself with a prospect of speedy recovery the illusion was broken by the recurrence of headache, accompanied by tightness across the chest and dyspnœa, aggravated by sore-throat, which, however, soon yielded to proper treatment. Towards the end of May the numbers attacked had greatly declined, but about the same time several surgical patients in the Hospital, who had long laboured under slight pulmonary catarrh, were suddenly carried off with symptoms which generally coincided with those above mentioned, in the order of their onset, viz., increased cough, quick small pulse, shivering, fever, vomiting, pain over the stomach or liver, great depression of nervous power, with dyspnœa—but without pain in the chest—followed by death. After death the bronchi were found to present appearances of a high state of inflammation. The substance of the lungs was dark red, gorged with bloody serum, and in some parts hepatized. In no other organs were morbid appearances discovered capable of accounting for death. Whether these cases, the occurrence of which is a well-known fact, should be referred to "Influenza," it is not possible certainly to affirm.

Milder cases continued to occur, though rarely, till the 1st of June, but the greatest number were observed during the first fortnight of May.

The treatment adopted was antiphlogistic, with anodynes and expectorants in severe cases. In no case treated in the Hospital was blood-letting found to be necessary. After the acute phase of the disorder had passed, depression of spirits and a harassing cough often continued for many days, and doubtless many cases of incipient pulmonary consumption were hastened on to a termination by the supervention of this disorder.

II.

ON SPINAL PARAPLEGIA.

Communicated to the Birmingham Medical Students' Society, 14*th November*, 1835, *and again read* 10*th January*, 1839, *with alterations and reports of six cases, illustrated by drawings, before the King's College Medical and Scientific Society.*

THE great difference in the method of investigating and considering disease pursued by writers of former centuries and those of our own day consists mainly in the degree of importance respectively attached to the two leading characteristics of all diseases, their symptoms and their pathological conditions. The overwhelming weight given to the former by early writers is a principal cause of the confused and unphilosophical arrangements so apparent in their voluminous treatises. It was this that occasioned them continually to class together under one name affections of the most opposite nature, because they had certain phenomena in common; and to draw distinctions between others essentially alike, because they presented themselves under circumstances they fancied dissimilar; and it is because pathology is now acknowledged to be the only sure foundation on which systems of medicine are to be raised that the labours of the moderns stand so far beyond those of their predecessors in the pretension they exhibit to philosophical classification and accurate detail. Accordingly we find that the researches of late years have been directed to obtain a correct knowledge of the unhealthy conditions of the various tissues of the body, and it is this wide and enlightened view of the subject which has led the way to so many valuable improvements in the science of medicine. But it may be useful sometimes to depart from this mode of investigation and endeavour to trace some single important symptom to the various organic changes in which it may originate. By adopting this plan, we shall more easily become acquainted with those peculiarities which are to guide us to a just diagnosis as to its nature and its seat. It is for these reasons that I shall attempt to consider our present subject apart from any isolated pathological change, but shall describe such as are connected with the spinal marrow as far as may be necessary to define the marks we possess of discriminating between them. There is an affection of the lower extremities of a very curious nature, which was once known under the name of "Pott's Paralysis," having been first particularly described by that illustrious surgeon; and to this I shall prefer first to direct your attention. Though called a paralysis, we are informed by Pott himself that he considered it in almost every respect totally unlike a paralytic affection, and even a cursory perusal of its features will convince anyone of the accuracy of his observation. It consists rather in a loss of control over the movements of the limbs, there is a loss of power of motion, the muscles being usually found in a state of rigid contraction, but sometimes alternating with painful and violent spasmodic jerkings. The extensor muscles especially are seen in a state of strong and almost continual action, so as to predominate over their antagonists, and cause the patient to assume attitudes in his attempts to walk, which are very peculiar and characteristic. The trunk and lower extremities are bent forwards, the pelvis being brought far behind any other part of the body; the thigh, leg, and foot form nearly a straight line; the heel cannot touch the ground, and an imperfect progression is performed upon the toes. The legs are somewhat separated from each other, and, when the will is strongly exerted to direct them forwards, they move from side to side, or involuntarily cross each other, in such a manner as to show that volition has just enough influence to disturb their spasm, but not sufficient to command their obedience. The muscles instead of becoming flabby and wasted, as in cases of ordinary paralysis, often acquire increased bulk and tonicity, and the difference is thus rendered striking between the appearance of the lower limbs in this and in other kinds of paraplegia. In the later stages, however, where the powers of the constitution are giving way and the general health declining under the gradual encroachment of the disease, this increased nutrition, as might be expected, ceases. The symptoms which have just been described are those present in a strongly marked case of this singular malady. At its onset, or in milder examples, the spasms are far less constant as well as less energetic, and indeed they may be so trivial as to produce nothing more than a slight awkwardness in the gait, or occasional tripping or losing of a step; but all these imperfections if carefully examined will be found to be essentially similar in nature. Sometimes, too, the flexor muscles are those mainly affected by this consensual spasm, though this occurs more rarely, and then generally in a modified form. Numbness is a symptom not unfrequently found complicating the disorder, and in some measure connected with this is a series of automatic movements (unobserved by the patient and independent of his will), which are liable to be excited in the affected parts on the application of an external stimulus. If, for example, the extremity be tickled, pinched, or otherwise irritated at any point of its surface, especially on the sole of the foot, where the nerves of sensation are most largely distributed, a movement having a voluntary character will immediately follow, the result of which will be the removal of the part from the source of inconvenience. Any sensation artificially excited will have some effect of this kind, though of course varying much in amount; and even that sense of discomfort or muscular fatigue which is a consequence of the too long retention of any one posture, appears to be experienced, and to occasion the motions requisite for obviating it; just as we notice in sleeping persons, in whom such attitudes are assumed in succession as are best adapted for procuring for every part the necessary repose. In a word, it is in this form of interrupted function of the lower limbs that the independent nature and exercise of those movements termed *reflex* or automatic are best and principally exemplified.

In most instances the nature of the affection will be placed beyond all doubt by the simultaneous occurrence of symptoms, more or less marked, of local disease in some portion of the spine. It is true these are not necessarily present, or do not become sufficiently prominent to attract attention, until the mischief we would remedy is too far advanced to be counteracted; but in the majority of cases some such symptom will exist. The adult will complain of a sense of weakness or pain referred to that part of the spine in which the morbid action exists—at first inconsiderable, but afterwards becoming more severe. The pain is increased by pressure, by running or jumping, or, in fact, by any motion which has the effect of jarring the spine. According to Brodie, in the advanced stage of the disease the pain is sometimes so severe and so easily induced, that the patient cannot bear the slightest movement. Yet in other cases there is no pain whatever in the spine from the first access of the disease to its termination. But in most instances—in those, at least, which are of any standing—in addition to the pain and tenderness before mentioned, a greater or less irregularity will be perceived in the spinous processes of the vertebræ. The distortion which it causes is of a peculiar kind. The spine is bent forward so as to form an angle projecting posteriorly, and it is evident that this cannot happen without destruction of the bodies of the vertebræ. With these evidences, then, of disease in the spine, we shall no longer be at a loss to what origin to refer the paralysis; and if any doubt could still remain, the absence of cerebral symptoms would dispel it. But it is an undoubted fact that organic changes may take place in some of the structures which compose the vertebral canal, formidable enough to produce paraplegia by an extension of their morbid action to the parts within, yet of so insidious a nature as to give no other evidence of their existence. The want of all the local signs of disease in the spine, and of any of the symptoms which usually mark cerebral disturbance, makes the task of forming a diagnosis by no means easy, and we must endeavour to bring to our aid indications—it is true, of a more equivocal and general character, but which may very possibly be of material assistance. We must examine carefully whether the paraplegia be of that peculiar kind that has been described; whether those appearances are visible in the constitution of the patient which are commonly termed scrofulous, and inquire into the probabilities there may be of an hereditary predisposition to it. In the case of two boys, where the obscurity here contemplated actually occurred, it was found that their mother had suffered for many years from mollities ossium, and only a short time previously had been fortunate enough to survive the Cæsarian section which had been rendered necessary by the great amount of distortion of her pelvis, occasioned by her disease.

But a condition is often met with which, though probably nothing more than a modified form of the foregoing, is nevertheless very dissimilar. I allude to that permanently "tucked" state of the lower extremities, which is commonly noted by authors and seen in the Hospital, accompanying the lingering progress of this distressing disease when it tends to a fatal termination. This may be thought by some to be in reality a mere result of the posture which the patient first assumes by choice, and then continues by habit till any change of it becomes at length painful or impossible; and I do not deny that such may at times be the correct explanation. But I think I have observed that this attitude sometimes partakes very much of the involuntary character of those already alluded to as marking the more common form of the disease. Having been thus originated it may be continued by habit, or may terminate in absolute paralysis.

An acute inflammation of the spinal cord, or its membranes, may also supervene suddenly (when the caries is thought to be in a quiet and inactive state), from the giving way of the vertebræ, thus producing pressure, or inflicting other serious injury on the contained organs. The suppression of any accustomed discharge, when the vertebræ are in a morbid condition, may also give rise to similar inflammations, and these would in all probability prove rapidly fatal without the occurrence of those peculiar symptoms which have been described; and truth obliges me to add that sometimes the progress of the symptoms is slow and yet unattended by any disposition to rigid contraction of the muscles. If these anomalies remain at present unexplained, I trust the account that has been given of the more usual course of the symptoms will not on that account be thought of less importance.

Regarding the pathology of this form of paraplegia, time compels me to be exceedingly brief. The disease may originate either in the bones, intervertebral cartilages or ligaments of the spine, and, according to the structure primarily affected, the train of symptoms which ensues will be subject to various modifications. It is probable that the same relation exists between the ulceration of the intervertebral cartilages and the softening and enlargement of the cancellous texture of the bodies of the vertebra as there does between the peculiar diseases of the analogous parts in the extremities, as was observed long since by Pott himself, and more lately by Brodie. In the bones the structure is similar, and accordingly we find that the scrofulous state of them, observed in certain cases of caries of the spine, is precisely similar to that met with in the strumous affections of the joints of children, and instances are on record of persons of adult age having laboured under the common ulceration of articular cartilages, in whom the intervertebral substances exhibited many marked deviations from their natural structure. Hence we may conclude that these are the morbid conditions which usually prevail in connection with this sort of palsy.

The mode in which the diseased action is propagated to the nervous substance so as to induce Paraplegia is the next branch of this interesting enquiry which demands our notice. Much difference of opinion exists concerning the proximate cause of those long continued contractions of the affected limbs, which form so remarkable a feature in this disease. It has been contended by some that they must depend on the slow and gradual pressure to which the spine is subjected when the vertebræ are bent out of their natural direction, or on the twist which is given to it when the pressure is slight. Others have believed that these symptoms are always referable to a slow inflammation excited by the neighbouring disease, or to an extension of the same morbid action to the contents of the canal. It seems to me the latter way of accounting for these phenomena is the most rational, and most in accordance with acknowledged facts. In the first place they may occur without the existence of any pressure whatever, and in these cases there has been found thickening or other diseased state of the dura mater with adhesions of its surface, increased vascularity of the pia mater, and sometimes softening of the spinal marrow.* Again, by judicious treatment, patients are occasionally cured of all paralysis, though the distortion (and of course the twisting) remains as before.

This view is also supported by analogy. In idiopathic arachnitis of the spine or head, and in the early stage of encephalitis, the muscles are affected with rigid spasms of a somewhat similar character. These several circumstances seem to make it probable that the Paraplegia I have described depends immediately upon a very gradual and subdued species of inflammation which has its seat in the spinal column and its investing membranes, sometimes upon actual pressure exerted on it.

To enter upon the treatment would render it necessary for me to curtail the observations which are to follow on some other modifications of spinal Paraplegia, and I shall therefore pass it over on the present occasion.

It will be advisable, in the first place, to say a few words respecting a chronic inflammation of the spinal cord, very analogous to that just described, excepting in its arising without any obvious cause. It is, however, of comparatively rare occurrence. Abercrombie and Ollivier mention instances of it, but without entering very fully into the subject, and all I can do is to give the substance of their observations. "There is generally some uneasiness in the back with paralytic symptoms, beginning in a part of a limb and in a slight degree, and advancing very gradually to confirmed palsy. The lower extremities are most commonly affected, but in some the arms only, in others all the limbs. There is sometimes permanent contraction of the affected limbs, and sometimes there are spasmodic affections of them, and the disease may go on in this manner for years, and at last be fatal by ramollissement. It is reasonable to believe that the affection is originally seated in a small part of the nervous substance, that it may continue for a long time in a state of simple inflammation, and then subside, or that it may terminate by a permanent change in the structure of the part, generally with some degree of induration. When it proves fatal, it seems to be so by passing either into ramollissement or into partial and unhealthy suppuration."

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* Case of Picken, with drawing. Case Book, vol. 3, p. 163.

In consequence of the similarity observable between the symptoms of this remarkable affection, and those which attend that species of Paraplegia where the disease of the bones is not manifested by the ordinary signs, it will be difficult, and often impossible, to distinguish between them in the earlier stages. But caries of the vertebral column, however obscure at its commencement, before it proceeds to any considerable extent, always affords some indication of its presence, such as distortion of the spine, or chronic abscess. This essentially chronic disease, on the contrary, whose sluggish nature is its most notable characteristic, may remain in a dull, inactive state for many years, and when it at length tends to a fatal termination, it is still without those distinctive local signs that mark the disease of Pott.

Acute inflammation of the membranes alone of the spinal cord, so far as I have been able to ascertain, is not attended with any paralysis. Where this has occurred, there has been commonly found an extension of the inflammatory action to the medulla itself, to which this symptom has been attributed. I shall therefore go at once to a consideration of acute myelitis, or inflammation of the substance of the spinal cord.

The first phenomena generally remarked at the onset of the affection, in addition to those of general pyrexia, consist of numbness of the fingers or toes, accompanied with a degree of constraint of their motions, and sometimes a disagreeable sensation of cold. These symptoms spread successively over the whole of the limbs, and extend to the trunk. It may happen that either partial or general convulsions occur from the commencement of the inflammation, without there having been any uncomfortable formication or difficulty of motion. Together with or shortly after the appearance of these symptoms, the patient complains of a deep-seated pain of a more or less acute character, in some point of the spine corresponding to the part of the nervous centre which is the seat of the inflammation. This pain may propagate itself throughout the whole length of the back and into the limbs, and according to some authors is exasperated by the movements of the body. But it is probable that this last symptom has been noticed in cases of spinal meningitis, that have been mistaken for inflammation of the spinal marrow itself. According to Klebs the pain is augmented by decubitus on the back, especially when the patient lies on a feather-bed and not a mattress. Sometimes no pain is discernible in the back, and we may then employ, in order more conveniently to apply curative agents, the method pointed out by Copeland (which Frank has often found advantageous), and which consists in carrying a sponge dipped in hot water along the course of the spine. When it arrives opposite the inflamed portion of the medulla, the patient immediately experiences a sensation of burning heat. It is also well to ascertain the height to which the pain extends by firm pressure or percussion on the spinous processes. This will frequently enable us to detect a morbid sensibility in parts which had hitherto never been the seat of any appreciable uneasiness; and in cases where pain exists, its being increased by this pressure will serve as a distinctive mark of its real nature, and will prevent us from falling into the error of confounding it with rheumatism.

Sometimes the paralysis pursues an upward course, gains successively the upper portions of the trunk, the superior extremities, and proceeding gradually, causes cessation of respiration and death by asphyxia. Sometimes it follows an opposite direction, and spreads itself from above downwards. In certain cases a loss of motion occurs without alteration of sensibility; in others, but more rarely, sensation alone is destroyed. The upper extremities, or one of them, may be paralysed before the lower, or *vice versâ*. The paralysis may also occur in a very sudden manner, so that the patient if walking shall instantly fall, quite helpless. This singularity has been observed also in many cases of cerebral ramollissement, especially by ANDRAL. M. CALMEIL, in a rather recent work on diseases of the spine, has also particularly adverted to it. These symptoms will also vary very much according to the region of the spine affected with inflammation, and also according to its extent. Motion or sensation will be impaired according as the anterior or posterior columns are its chief seat, as many observations show. When the myelitis exists in the dorsal or lumbar regions the lower members are alone affected, and the upper extremities suffer only when the cervical portion of the spinal marrow is inflamed. But cases are on record which prove that it is not always thus, and that parts situated below the disorganised point may sometimes preserve both motion and sensation. This circumstance is, however, a rare exception to the usual course of the symptoms. There are numerous other distinctions which physiology would lead us to anticipate in connexion with the different regions which, however, have little reference to the immediate subject of this paper. I shall content myself with extracting the following passage from OLLIVIER: "Paralysis of the lower limbs," says he, "with involuntary discharge or retention of the excretions, is observed especially in cases where the inferior part of the dorsal portion and the lumbar portion or rather the inferior bulbous extremity of the medulla is the seat of inflammation. The patient experiences a deep-seated pain, confined to the region of the loins, sometimes with severe colic, convulsive contractions of the abdominal parietes, or a feeling of great tightness around the waist."

Acute myelitis may terminate fatally in a few days. The post mortem appearances may be classed under the following heads. Ramollissement, undefined suppuration, abscess. Induration is also mentioned by some authors as being by no means an uncommon result. I am not aware that these can be distinguished from each other until the scalpel reveals them; and it is doubtful whether any practical benefit could be derived from a more exact knowledge of their distinctive signs, did such exist. The diagnosis between the paralysis arising from acute inflammation of the medulla, and that attending the forms of disease first mentioned, will require no further comment than what a bare enumeration of their symptoms has already afforded.

I shall next speak of congestion, and of serous and sanguineous effusions in the spinal cord as causes of Paraplegia. Retardation of the circulating fluids may exist in almost every possible degree, and it may be acute or chronic, and of an active or passive character. To congestion and distension of the vertebral sinuses and veins, certain pains in the back and inferior members, sciatic neuralgias, slight lameness, trembling and convulsive movements, and even torpor or paralysis of these members, as well as several epileptic and tetanic phenomena, may not unreasonably be attributed. A sudden paralysis of the limbs, followed by asphyxia from impeded respiration, may take place, and no other morbid appearance be met with than a preternatural engorgement of the vessels of the cervical spine. The congestion may likewise be chronic or habitual, in the same manner as local congestions continually occur in other parts of the body. By long continued distension the venous trunks acquire a varicose and dilated state and become very liable to fresh and sudden accessions, especially on the cessation of any accustomed discharge, and which may be fatal by rupture of their coats, and extravasation of their contents. In this manner we may account for some of those cases in which the patient, for a number of years, is liable to occasional numbness in some part of the body, and is finally carried off by a sudden attack, though in these the brain will generally be found the organ chiefly affected. The appearances after death from congestion of the spine are generally of a character easily recognised, though it must be allowed often ambiguous, from the liability there is of cadaveric changes being mistaken for them. This circumstance will always make it difficult to ascertain with accuracy the peculiar symptoms which may be referred to this state of the circulation, and I believe little certain is known on the subject. As any impediment to the transmission of the venous blood through its natural channels in other parts of the body will prove a constant cause of a separation of its serum through the capillaries, so there can be no doubt that this is a frequent source of serous effusion within the spine. Serous effusion may occur as a result of inflammation of the membranes, or it may gravitate from any part of the contents of the skull within the dura mater.

The vertebral canal in its healthy state is very far from being filled by the medulla spinalis. At its posterior and lateral parts the dura mater is loosely connected with the bones, and the subarachnoid cavity contains as much as two ounces of serum, and sometimes more. Any increase of this quantity will necessarily exercise compression on the spinal cord, and the symptoms will be of corresponding nature; convulsions occurring in paroxysms, and Paraplegia of the inferior extremities. The patients will often die comatose from simultaneous occurrence of effusion in the brain. When the serum is found within the dura mater there is great probability that it may have percolated the tissue of the pia mater, or have fallen to the lower part of the arachnoid cavity. In these cases there will, of course, be found considerable effusion on the hemispheres, and at the base, and very probably within the ventricles. The serum found here may differ in colour or appearance from that met with in the cord, and when this happens, it will furnish a strong presumption that they are independent of each other.

Extravasation of blood in the spinal canal may take place external to the dura mater, between the membranes, or in the substance of the medulla. It is of very rare occurrence, and is generally the consequence of some external injury or previous disease. It may also be occasioned in a subject predisposed to apoplexy, or by any strong irritation of the part, such as that excited by strychnine. The seizure will, of course, be sudden, and will be attended with no disturbance of the intellect. There will be pain, often very severe, in the situation of the extravasation, with general convulsions and palsy of the parts situated below. The duration of the attack will vary very much with the region in which the lesion exists, sometimes not exceeding a few hours, in other instances amounting to several days or even months. When the hæmorrhage is of small extent, it is probable that recovery will take place, and it is reasonable to conclude that similar changes to those which are effected in the brain after sanguineous effusion, whether of a reparative or destructive kind, may equally occur in connection with this disease, when the cord is the seat of it. In consequence, however, of the great scarcity of well-observed cases, it must be admitted that this statement rests almost solely on analogy. Certain diseases, which materially alter the tissue of the spinal marrow, or which, developed in the neighbouring parts, press upon this organ and impede its functions, must now claim some share of our attention.

Under this head may be included cancer, and its varieties; tubercle, fungous, fleshy, or osseous growths, hydatids, or aneurysmal tumours, &c. Their usual symptoms are those which accompany any slow compression of this organ, and they vary according to the height at which the organic lesion is placed, and according as it occupies the whole cord, or only a part of it. Thus, when an organic lesion it situated in the lumbar region, if it be as yet slight, and presses upon or destroys only a portion of the medulla, there may be numbness, pain, insensibility, and difficulty in moving the lower extremity of the same side as the organic lesion. In proportion as the disease presses upon the whole cord, will the Paraplegia be more or less complete. At length, after the lapse of various periods of time, according to the nature and progress of the disease, the Paraplegia becomes complete. The patient drags on a miserable existence, which at length terminates by the formation of gangrenous eschars on all the parts upon which the weight of the body rests. Cancer of these parts (of the spine) may perhaps be recognised by lancinating pains, returning at intervals, which are most frequent towards the end of the disease; by the yellowish, pallid tinge of the skin; by the existence of cancer in another situation; and the age of the patient, since it is rarely that this disease attacks very young subjects. Tubercle may sometimes be known by the presence of this disease in another organ; by the age of the subject, ordinarily young; and by the absence of the preceding signs. Osseous tumours may co-exist with tumours of a similar nature, visible externally, or with a general syphilitic taint.

Aneurysmal swellings will most probably be recognised by their usual symptoms As for the other diseased growths, it is, I believe, impossible in the actual state of science to assign them any certain characters, but their extreme rareness and incurability makes this a matter of little regret. I have met with a case in which the disease was fungoid and sufficiently easy of diagnosis as it appeared externally. The bones which protect the spinal marrow are of such strength and thickness, and are so amply covered by the muscles, that a fracture of them is rare. When it occurs the displacement which attends it, and the shock given to the cord are so great, that Paraplegia is the nearly constant result. The displaced vertebræ may so press upon the spinal cord as to effect a complete laceration of it, without any rupture of the membranes. If the injury is situated above the origin of the phrenic nerve death immediately follows; if below, the patient may live for many days, and sometimes for several weeks, but the attempts to repair the mischief usually produce so much irritation in the cord that irreparable disease or a lingering death is the result. But the spinal cord may receive most serious injury without fracture of the vertebræ, though probably never without some degree of violence being inflicted either on the ligaments or intervertebral cartilages. In these cases paralysis may immediately supervene and gradually disappear, or it may follow after a considerable interval of time, proving eventually fatal. In nearly all the cases in which Paraplegia follows an injury to the spine some vessels are ruptured and blood is effused, which may cause an aggravation of the symptoms. This extravasation, however, may take place without any injury being apparent in the adjoining parts, from the mere effect of the violent concussion occasioned by the blow. The Paraplegia will not in this case be instantaneous, and the patient will perhaps rise after the accident and walk some distance; but in the course of a few minutes as the blood flows paralysis will supervene. If it is external to the membranes, and proper treatment be employed to prevent a recurrence of the hæmorrhage, the paralysis will soon partially disappear in consequence of the extravasated fluid becoming spread over a larger surface, and thus pressing less forcibly on the medulla. As the blood is finally absorbed complete recovery may ensue, an instance of which, I believe, I have had an opportunity of witnessing.

Some ambiguity will often arise in the diagnosis of chronic cases of Paraplegia, which depend essentially on disease of the spine, from the co-existence of certain doubtful symptoms of cerebral disorder, which the practitioner, aware of the acknowledged obscurity of some organic lesions of the brain, sometimes allows to throw a veil over the real cause. These generally originate in a slow extension of inflammatory action along the membranes or medullary substance of the cord up to the brain itself. But these should be carefully discriminated, and to do this it is necessary to ascertain which set of symptoms were the first to appear. It will often be found that those connected with the head have been consecutive to the others. When the disease depends upon the spine, some local tenderness, fulness, or prominence will commonly be found, if searched for, in some portion of the back; and if this is present without much disorder of intelligence, or other clear evidence of cerebral disease, we shall probably be not far wrong in considering it to be *spinal* paraplegia. If, on the contrary, there are present marks of a disturbance of the functions of the brain without any such local signs of spinal disease we may conclude otherwise.

There are also other anomalous kinds of paraplegia of an hysteric character, which will generally be recognisable from their intermissions, and from the subjects in whom they appear; and some cases, occurring in connection with disease of the kidneys without any appreciable spinal lesions, were published some years ago by Mr. STANLEY. The symptoms, however, by which these are to be discriminated, are quite unknown, and such forms are thought to be extremely rare.

III.

ON HÆMORRHAGE FROM EXTERNAL INJURY.

Written in the Spring of 1834. *Read before the Birmingham Medical Students' Debating Society.*

If there is one subject more imperatively demanding the attention of the surgeon than another, it is that which we are about to take into consideration this evening. At no time, and in no situation will so much coolness, promptitude, and judgment be required, nor so thorough an acquaintance with the means which lie within his power, be necessary, as on an occasion of alarming hæmorrhage. Unlike most of the other great duties which devolve upon him, this is sure to come at an unlooked for moment, and often under the most disadvantageous circumstances of time, place and opportunity. If the bleeding be profuse, and a strong sense of danger arise in the minds of the bystanders, their terror and confusion will be tenfold increased; and thus it usually happens that the difficulties which stand in the surgeon's way are multiplied, in proportion to the necessity there is for overcoming them. Let it be remembered that it is a perfect knowledge of the various means and principles of restraining hæmorrhage that alone can give him confidence in the hour of trial, and enable him to direct his measures with the calmness and decision essential to success. At such a crisis ignorance is culpable, and entails not only bitter reflections, but just disgrace.

Hæmorrhages may be classed, first into *arterial* and *venous.* They may also be divided in a different way, viz., into those which originate in general causes, and occur in internal organs; and those which arising from specific external cause, require chiefly a local treatment, and though this plan is liable to some objections, I shall partly adopt it here. Among the former may be included sanguineous apoplexy, epistaxis, hæmoptysis, hæmatemesis, hæmaturia; cystorhagia, with uterine and hæmorrhoidal hæmorrhages, and many others. Nothing more than a bare mention of these is now necessary. Of the latter form may be enumerated—bleeding from wounds of every kind, and this is by far the most numerous and important class ; from sphacelation of aneurismal sacs, from ulcerations, from sloughing, from fungous growths, and from varicose veins.

In the following remarks I purpose to confine myself chiefly to a consideration of the effects of wounds of arteries. The nature of the enquiry appears to require that I should first point out the general consequences resulting to the system from loss of blood, single or repeated ; next, to recount the means employed by nature and art to secure the patient from further loss of blood, and the local changes consequent on a failure of these ; and lastly, to add a few words on what has been aptly termed the hæmorrhagic temperament.

1st. Syncope may be considered to be the first of the decided effects of loss of blood. Before it can take place certain conditions must be fulfilled. The patient must have a requisite degree of strength. The flow of blood must be sufficiently rapid, and an upright posture must be more or less maintained. These are generally essential, and when one or other is wanting a state bordering on death is produced far different from syncope. In syncope, occurring as an effect of hæmorrhage, all the phenomena appear to be dependent on a sudden abstraction of blood from the brain. The languor of the eye and of the expression, the peculiar affection of the respiration, the sudden diminution or cessation of the heart's action, the loss of power over the voluntary muscles, the nausea and relaxation of the sphincters, all originate in this. There are also other facts connected with it which plainly show that fainting depends mainly on the condition of the brain, and only in a secondary degree on that of the heart itself. Syncope, when connected with hæmorrhage, is the first, and one of the principal of nature's resources for its suppression, and instead of its being regarded, as is frequently the case with the inexperienced, in the light of an evil to be avoided, it should be encouraged by assuming the erect posture. When once procured, however, the horizontal position is to be resumed, as sudden dissolution has not unfrequently occurred from a neglect of this precaution. The countenance becomes pale and sunk, the energy of the brain is lost, the action of the heart gradually ceases, the surface and extremities are cold, gasping respiration succeeds at more and more distant intervals, and the patient at length sinks exhausted.

But it is not always that the train of symptoms I have related follows a copious hæmorrhage. It has been noticed by several distinguished pathologists—among others by Dr. MARSHALL HALL, Dr. KELLIE, and Dr. ARMSTRONG—that the brain is sometimes affected by loss of blood in such a manner as to cause convulsions. Dr. KELLIE observes that "fits resembling apoplexy and epilepsy, as well as fits of syncope, occasionally supervene to venæsection of the arm," and Dr. ARMSTRONG states that "bleeding to syncope in young children may sometimes lead even to fatal convulsions."

The action of the heart returns to its usual standard after an ordinary faintness produced by loss of blood, provided the cause be removed. The power by which this is effected is one inherent in our constitution, and has been denominated reaction, but after repeated abstractions not sufficiently great or sudden to produce death, a state of excessive reaction supervenes, that presents a highly interesting series of phenomena, a study of which is of the utmost moment. Upon due information on this point depends almost the whole of our after treatment in many cases of hæmorrhage, and numerous instances are on record in which the irritable and throbbing beats of the arterial system, consequent upon it, in conjunction with other fallacious symptoms, have led to the adoption of a treatment as fatal as it is indiscriminate. I allude more especially to that mistaken practice of bleeding when the system is no longer competent to rally, and when every succeeding drain, though productive of temporary alleviation to the sufferer, but tends to hasten dissolution.

As the phenomena of syncope appear to be altogether referable to a peculiar condition of the brain, so those of excessive reaction depend as obviously on an affection of the heart and arteries. In proof of this it may be observed that the affection of the brain in syncope is immediately followed by disorder of the respiration, of the circulation, and of the functions of the digestive organs, while in excessive reaction on the contrary, the organs of the circulation are alone impaired; there is an absence of those that mark cerebral lesion, the respiration may be quickened, but the senses maintain their seat, the eye does not lack vivacity, the expression and the manner are lively, the appetite is good. Even the process of assimilation goes on uninterruptedly within certain limits. One of the dogs subjected by Dr. MARSHALL HALL to the loss of blood, gained half a pound in weight instead of losing, although he had been bled seven times and lost 35 ozs. of blood in the space of a week.

In excessive reaction there is a peculiar irritable, jerking pulse, for the most part easily compressible. Many arteries of moderate size are now felt and even seen to throb, which in a healthy state cannot be distinguished. In extreme cases, the inordinate action of the heart is attended with a sound like that caused by a saw or file—called by the French "bruit de râpe," and in the more exquisite forms which occur chiefly in those of vigorous constitution, there is a throbbing pain in the head—the energies and sensibilities of the brain are morbidly augmented. There is intolerance of light and sound, and sometimes fearful dreams from which the patient starts in a state of temporary delirium. Mr. Cook, in his able abridgment of Morgagni, says that he has observed the symptoms of cerebral fulness and local congestion after copious depletion, even when the general circulation was feeble and the extremities cold, and he attributes it to mental excitement from very slight causes.

To excessive reaction there occasionally follows another distressing train of symptoms, preceding dissolution, mainly depending on a diminished energy of the brain from defective stimulus. The heart loses its full and throbbing beat, and the pulse its jerk and power; there is a tendency to dozing; the eyes are dim, the lip falls, the respiration grows deep, laborious, and effected chiefly by the diaphragm and abdominal muscles, the accumulated secretion of the air passages giving rise at every effort of the patient to a prolonged rattle ; the action of the sphincters is impaired ; the pulse becomes feeble, and the state of the secretions of the stomach and intestines is disordered, accompanied with a total loss of appetite. The last stage is denoted by a pale and sunk countenance, inquietude, jactitation, delirium, and coldness of the extremities, and gasping convulsively at longer and longer intervals, life ceases.

2nd. Let us now turn our attention to the means employed by nature to stop hæmorrhage from wounded arteries. It has been matter of surprise to some that this division of our subject, upon an acquaintance with which we must necessarily ground our practice, should, for so many centuries, have been involved in doubt and obscurity, and should have received little or no elucidation from the experience and zeal of our early writers. This we cannot but lament, for so extensively is almost every department of surgery connected with this, that the progress of the art has been for ages retarded, and terrible, though often unsuccessful, treatment employed from deficient information on this point. The older surgeons seldom ventured on the most trivial operation without a constant dread of hæmorrhage, and we turn to more recent times to find how a diligent search after truth, aided by careful experiments and strict induction, has at length enriched our knowledge, and conduced to the introduction of many celebrated improvements of modern surgery. It will be sufficient if I allude to the immense contrast existing in the different success of amputations and of operations for the cure of aneurism at the periods I mention.

The process employed by nature for the suppression of hæmorrhage and the reparation of wounded arteries is not the same in every instance, but differs according to the degree of injury the coats of the vessel have sustained. If it amount to a simple puncture only, and the external opening be not too free, the impulse of the blood causes the cellular membrane connecting the artery with its sheath to be injected, and a thick layer of coagulum is formed which closes the orifice of the vessel. In a few hours the cut surfaces of the artery inflame, and the wound is healed by the adhesive inflammation. When the injury is small the integrity of the canal remains, and after a time the cicatrization cannot be discovered either on its internal or external surface ; but when the wound is more extensive, a larger quantity of lymph is poured out, which in some measure obstructs the canal of the vessel.

But in severe transverse wounds, and complete divisions of arteries, a process wholly different takes place. As union of the cut extremities is prevented by the retraction of the vessel within its sheath, the obliteration of its canal is effected, nutrition to the parts which it supplies being carried on by means of collateral channels.

It was Petit, the surgeon, who first endeavoured, about a century ago, to explain the means which nature employs for the suppression of hæmorrhage. He conceived that bleeding from a divided artery is stopped by the formation of a plug of coagulated blood, situated partly within and partly on the outside of the extremity of the vessel.

This plug he thought afterwards to become attached to the inside of the vessel, to the cut extremity, and to the surrounding parts. MORAND, a few years after, published additional observations. Allowing that the coagulum had some effect in restraining hæmorrhage, he contended that a constriction of its circular fibres, by which the calibre is diminished, and the retraction and consequent thickening of its longitudinal fibres, were the principal means by which the canal of the vessel was closed. SHARPE, also, was of this opinion. PONTEAU considered that the tumefaction of the cellular membrane, at the circumference of the extremity of the divided artery, furnished the principal impediment to the flow of blood. GOOCH, WHITE, AIKIN, and KIRKLAND, asserted that it was owing to the constriction and retraction of the extremities of the divided vessel that hæmorrhage was suppressed, and Mr. JOHN BELL fancied that when hæmorrhage stops of its own accord it is owing solely to the cellular membrane which surrounds the artery being injected with blood.

These theories all impute the suppression of hæmorrhage to one or other of the attendant circumstances, to the exclusion of such as certainly form a conspicuous part of the process, and it was not till Dr. JONES published his elaborate work in 1805, that the true pathology of the subject was fully understood. He demonstrated that the blood, the action, and also the structure of arteries, their sheath and the cellular membranes connecting them, as well as the soft parts adjoining, were all concerned in stopping hæmorrhage from a wounded vessel. By an extensive course of well conducted experiments, he was enabled to prove that a sudden retraction of the artery within its sheath and a slight contraction of its extremity, were immediate and also permanent consequences of its division. In withdrawing itself within its sheath, it lacerates or stretches the cellular fibres connecting them, and these tend to entangle the blood as it flows. The blood passing externally is extravasated between the vessel and its sheath, and into the cellular membrane in its vicinity in proportion to the open or confined state of the wound. Thus a coagulum is gradually formed in the sheath and surrounding parts, which is the first complete barrier to the flow of blood. The formation of this clot would not so speedily be effected if the action of the heart and arteries was not diminished in proportion to the rapidity and extent of the abstraction of blood from the system. When fainting occurs, the impetus of the blood is almost wholly removed, and its coagulation proceeds without interruption. The mouth of the artery being no longer pervious, nor a collateral branch very near, the blood just within it is at rest, and forms in general a slender conical coagulum, neither adhering to its sides, nor filling its cavity; but attached by its base to the external clot, the one first described. In a short time the cut end of the artery inflames, and the vasa vasorum pour out lymph between the external and internal coagula, which adheres to them, and in some measure is intermingled with them, and which is firmly united all round to the inner coat of the vessel. It is on this coagulum of lymph that the permanent suppression of hæmorrhage depends, and while it is forming within, the extremity of the artery is further secured by a gradual contraction which it undergoes, and by an effusion of lymph between its tissues, and into the adjacent parts. Lastly, the extremity becomes blended with the surrounding structures, the continuity of the canal as high up as the next lateral branch is lost, and a thin ligamentous cord alone remains. Meanwhile the current of blood is determined to the collateral arteries, which enlarge and become capable of supplying those parts which would otherwise be deprived of circulation on account of the destruction of their own vessel.

Dr. Jones's experiments prove that an artery if injured only to a moderate extent is capable of complete reparation, and that even oblique and transverse wounds, if not exceeding a fourth of the circumference of the artery, are enabled to reunite and heal so as to afford no material obstruction to the flow of blood. It is not easy to ascertain the exact degree to which an artery may be wounded, and the continuity of its canal nevertheless preserved; for if the wound is large and still capable of healing, yet the quantity of coagulable lymph poured out is so great as more or less to impede the onward current of the blood, and if the wound is larger the remaining fibres speedily become torn or ulcerated, and the ends retract within the surrounding parts. It is this operation of nature that surgeons have accelerated by completely severing a bleeding artery that has been merely punctured or partially divided.

The means by which hæmorrhage from a *lacerated* artery is suppressed are the same as when an artery is wounded or divided by a cutting instrument. They are, however, frequently more certain of their end in consequence of one or two circumstances which I will advert to. The vessel is usually separated in some measure from its connections, which, by causing a greater irregularity of the surface of the wounds, allows of the more speedy retention and coagulation of the blood about the mouth of the artery. Again, the internal coats are often more extensively abraded in lacerated than in cut arteries, and a larger quantity of adhesive lymph is thrown out on their surface, to which the internal coagulum intimately adheres. But it cannot be denied that where the effect of a severe laceration is to divide the coats of the artery in an uneven or irregular manner, the wounded surfaces will not in all probability be opposite each other, consequently no union can take place between them, and secondary hæmorrhage will ensue.

3rd. The processes of nature being in most cases of dangerous external hæmorrhage wholly inadequate to sustain life, the aid of art has been from the earliest times invoked to second them. I shall proceed to notice in a cursory manner the various surgical means which have been adopted with this view. The most obvious, and certainly the most effectual of these is pressure, applied either to the trunk of the bleeding artery or to the wound itself. It is on this principle that the tourniquet, the ligature, and the application of a roller and compresses, become useful in the suppression of hæmorrhage. The actual and potential cautery, and styptics, however, have a different mode of operation. If we for a moment glance at those numerous remedies denominated styptics, which at different periods gained a fleeting popularity as specifics against hæmorrhage, and remember the ill-success attending the practice of the older surgeons, we shall be convinced of their inefficiency in cases where any artery of even moderate size is wounded. From a consideration of their almost universally irritating nature, the most judicious practitioners of the present day seldom employ them in recent wounds. Cold, however, which, no doubt, has a styptic quality, is to be excepted. Their application is sometimes indicated in bleedings from ulcerated surfaces, where the vessels appear to have lost their natural disposition to contract, or cannot be secured by the ligature. Styptics seem to exert their beneficial influence in restraining hæmorrhage by promoting the contraction of the vessels. Sponge and agaric, substances which have usually been classed under this head, appear to act rather on the principle of pressure. By their soft and yielding properties they insinuate themselves into all parts of the surface, at the same time that their porous nature, arresting the blood as it flows, accelerates the formation of the coagulum. The actual and potential cautery, formerly so much used, are now almost entirely laid aside. The latter is occasionally applied to hæmorrhages occurring after the extraction of teeth, and the application of leeches; and in other cases where the bleeding is obstinate and the situation or nature of the part precludes the possibility of tying the vessel.

Compression is one of the most certain and simple modes of putting a stop to any bleeding which arises not so much from any individual vessel as from a general surface. Surgeons formerly stuffed the cavities of wounds with lint and charpie, making pressure at the same time by means of a roller applied tightly over the part, but this practice has been justly abandoned. It has been advantageously retained where a large artery is wounded in a situation where it is impossible to apply the ligature. If compression be attempted when an artery has been merely punctured, and the external wound is slight, the integuments are to be brought together and the compresses to be placed over them. When an artery runs superficially over a bone, compression may sometimes be resorted to successfully in place of severer measures. The tourniquet is an instrument which acts on this principle. Its advantages are that it makes the principal pressure on the point where the pad is placed, viz., the main artery of the part; that this pressure can be regulated with the utmost exactness, and does not require the aid of an assistant to preserve it; that it can be relaxed or tightened in an instant; and, that when there is apprehension of secondary hæmorrhage, it may be left loosely round a limb, ready to be tightened at a moment's warning. It is only used in cases of profuse bleeding, until further means are undertaken for its suppression, the effects of which are more permanent. This instrument was totally unknown to the ancients.

Although mention is made of tying the vessels for the purpose of stopping hæmorrhage both by Celsus and Galen, the ligature was not brought into general use till the time of Ambrose Paré, who employed it in amputations. The insecurity of those means I have already spoken of renders this by far the most safe and certain method of treating wounded arteries; and it may be considered as an established rule in surgery that whenever a large artery is injured no styptic application should ever be employed, but immediate recourse had to the ligature. When an artery is properly tied the internal and middle coats are completely divided, the wounded surfaces are retained in exact apposition, and the circulation of the blood through its canal is stopped. The end of the artery next inflames, and lymph is poured out, which permanently and effectually unites the wounded surfaces already in contact, and by becoming effused for some extent between the coats and on the surface of the wound, the ligature is enveloped in it. The thread then acting as a foreign body, causes sloughing of that portion of the external coat of the vessel situated immediately within its ring, which is soon separated by ulceration from its attachments and comes away with the ligature. Finally, the canal of the artery is generally obliterated both above and below the part where it was tied, as far as the first lateral branches. This latter effect, however, is not constant. The circulation to the parts remote from the heart is carried on by means of collateral vessels, as in the case of division of the artery before mentioned.

On account of the free anastomoses existing between different parts of arterial trunks, in every region of the body, it is necessary in case of a wounded artery, to secure both ends with the ligature: a neglect of this precaution has more than once proved fatal.

Much has been said and written with regard to the sort of ligatures to be used and the manner of applying them. It is now, I believe, pretty generally acknowledged, that the description recommended by Dr. Jones best promotes the successful progress of the several steps I have noticed. He considered those preferable which are round and very firm, and particularly deprecated the use of such as were broad and flat. In the application of them he cautioned surgeons against a then prevalent fault, that of not tying the knot sufficiently tight, by which a division of the internal coats, and consequently a union of their surfaces, fails to be effected.

4th. It sometimes happens that the measures adopted by the surgeon for the suppression of hæmorrhage are found of no avail; and that notwithstanding every precaution both in the local and constitutional management of his patient, secondary bleeding will occasionally occur. A few of the causes likely to induce this may be briefly mentioned. The old practitioners, whose imperfect knowledge of the true use of the ligature obliged them to resort to that most revolting of all remedies, the actual cautery, as a means of restraining hœmorrhage, frequently had the mortification of seeing their patients sink from the effects of renewed bleeding on a separation of the eschar. Even the ligature itself does not succeed in certain cases. If completely flat or irregular it is apt to cut through the middle and internal coats of the artery more completely at some parts than others, and by extending beyond the point of adhesion, and exciting ulceration, it will expose the cavity of the vessel and give rise to hæmorrhage. If the thread be applied in an uneven manner, so as not to form a circle round the artery, as the fibres gradually retract or partly ulcerate, the loop will be too large to constrict the tube, and consequently it will become loose and liable to be thrown off. The same effect will probably follow if other substances are included in the ligature. Sometimes, in consequence of a morbid condition of the coats of an artery, the usual effusion of lymph will not take place, but the inflammation will terminate in ulceration or sloughing. The importance of absolute quietude in promoting the union of wounds in general, indicates the necessity for its observance after the ligature of an artery. The facility with which newly cicatrized surfaces are torn asunder shows how easily the slender and recent adhesion at the extremity of a tied artery may be overcome by the movements of the patient, and points out the important caution, that of not endeavouring by force to expedite the detachment of the ligature. There are other circumstances which may tend to the occurrence of secondary hæmorrhage, but it will not be suitable to occupy your time with a further enumeration.

5th. In connection with the present subject, it remains for me to say a few words relative to that peculiar disposition to excessive hæmorrhage from the slightest causes which exists in certain individuals. There is usually no difficulty of stopping the bleeding for a few hours, but it invariably returns. On removing the dressings and clearing the coagulum from the wound, it soon ceases, appearing not so much to issue from any particular vessel, as to be a universal oozing from the surface. The surgeon applies caustics, compresses, and a tight roller, but in the course of a short time he is alarmed by a recurrence of copious bleeding. The patient may recover at length by the application of a powerful escharotic, or by freely laying open the wound, and removing all pressure, but when he next receives any injury, the probability is that in spite of all surgical skill he will sink from exhaustion, the hæmorrhage failing to be suppressed by the actual cautery or even tying the trunk supplying the part. A case of this nature occurred in 1817 and was recorded by Mr. Blagden, in which the bleeding arose from the extraction of a carious tooth, having before occurred on a similar occasion, and from a wound in the head. Three analogous instances of this serious affection were admitted into the Birmingham Hospital about the same time, and all proved fatal; and there has been one within the last twelvemonth. I am not conscious that anything certain is known of the proximate cause of this peculiar hæmorrhagic temperament.

IV.

EXTRACTS

From 'A Treatise on the Diseases and Injuries of the Larynx and Trachea,' *by* Frederick Ryland, *Surgeon to the Town Infirmary, Birmingham, published in* 1837, *and founded on an Essay, now in the Archives of the Royal College of Surgeons of England, for which* Mr. Ryland *obtained the Jacksonian Prize in* 1835. *The Cases and Drawings here reproduced from the Treatise were communicated to* Mr. Ryland *by his friend,* Sir William Bowman, *then* (1832-1837) *House Pupil in the Birmingham General Hospital* (*containing* 180 *beds*).

Case.—Œdema of the Glottis, with Glanders. ('Treatise,' p. 54, Plate I.)

William Wilcox,* aged 41, a groom of temperate habits, was engaged, in March, 1835, in skinning a horse which had died of glanders. On the previous day he had run a thorn into the palm of the left hand, and he supposed that matter from the dead horse had come into contact with the sore. On the following day the hand was swollen, inflamed, and excessively painful; it continued so for five weeks, when the inflammation suddenly receded from the hand and made its appearance on the inner side of the arm, a little above the elbow. In a few days it disappeared from the arm, and the thigh and calf of the right leg were similarly affected; these remained inflamed for some time, but in October he recovered completely and returned to his work.

In January, 1836, the same local inflammatory affections recommenced, and the right shoulder, the ankle, the knee, and the elbow, were consecutively attacked. On the 12th of July, at which time he was under the care of Dr. James Johnstone as an in-patient of the Birmingham General Hospital, his state was as follows:—Slight swelling and undefined erythematous redness about the right elbow, a sharp and gnawing pain in the knee, which is very tender on pressure, absorbents on the inner side of the thigh inflamed; great anxiety of countenance, flushed cheeks, tremulous action of the muscles, hurried respiration, pulse 120, small and weak, thirst, and foul tongue.

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* W. B.'s 'Case Book,' Vol. iii., p. 106.

21st. Regular nocturnal delirium, muscular tremor almost constant; there is a wild and exhausted expression of countenance. Pulse 136, weak and fluttering. 23rd. Muttering delirium night and day, constant tremors, pulse 140, skin hot and dry. Respiration much accelerated and accompanied with a loud sound. At 5 p.m. of the same day the respiration was very much hurried, and each inspiration was attended with a crowing noise audible at a considerable distance. Pulse small and very rapid, profuse perspiration, lips blue. No tenderness of the larynx on pressure. He continued in this state till 10 o'clock, when he died suffocated.

Dissection, Eleven Hours after Death.—Body muscular and rather fat. The periosteum of the tibiæ was thick, soft, and easily detached from the bones, and within its substance abscesses were found. All the glands of the body were healthy.

Head.—A very vascular gelatinous membrane was found within the arachnoid, on the surface of the brain, but more adherent to the dura mater than to the convolutions. The brain throughout was firm, and had a slight pinkish mottled appearance.

Throat.—The orifice of the larynx was almost closed by a yellow, semi-transparent, œdematous swelling of the sub-mucous tissue of the lips of the glottis (Plate I.); the œdema extended also to the cellular tissue beneath the mucous membrane which covers the posterior part of the larynx and to the right tonsil, but the epiglottis was unaffected. Several vessels were seen penetrating the anasarcous tissue and ramifying in a very beautiful manner as they approached the surface. The mucous membrane lining the cricoid cartilage for the space of half an inch was of a light-green colour, inclining to violet, and covered with many yellow dots, where purulent matter was advancing to the surface, and in some situations the membrane was perforated and pus escaped. (Plate I*a.*) On cutting through the mucous membrane the sub mucous tissue was found infiltrated with greyish pus. The inner surface of the cricoid cartilage was converted into a ring of bone, which was loose, and carious, and in contact with the pus. The trachea, bronchi, and lungs were healthy.

CASE.—ERYSIPELAS EXTENDING TO THE LARYNX FROM THE FACE. ('Treatise,' p. 68.)

THOMAS SIMPSON,[*] aged 35, a groom by occupation, was admitted into the Birmingham General Hospital under the care of Dr. BOOTH, on the 10th of November, 1834, affected with hemiplegia, for the relief of which a seton was introduced in the back of the neck. On the 22nd erysipelatous inflammation commenced around the seton; by the 24th it had extended to the cheeks. 27th. There was sore throat and

[*] W. B.'s 'Case Book,' Vol. ii., p. 64.

great difficulty of swallowing. 28th. It is with extreme difficulty that the patient can swallow even a tablespoonful of broth; he lies in a state of stupor, with occasional delirium. 29th. Deglutition worse, coma, respiration quick and sonorous, pulse 140. He died during the night.

Dissection, Eighteen Hours after Death.—The mucous membrane of the fauces was highly inflamed, and covered with flakes of recent lymph. The epiglottis was inflamed and tumefied, and its sub-mucous tissue was infiltrated with pus. Beneath the investing membrane of the lips of the glottis and the upper parts of the larynx, the sub-mucous cellular structure was in a sloughy condition and loaded with purulent matter.

The details of the progress of disease in this case are rather meagre, but they show, in a manner sufficiently distinct, the extension of the inflammation from the cheeks to the fauces and pharynx, producing sore throat and impeded deglutition, and its farther extension to the larynx, when the breathing became quick and sonorous.

CASE.—PHLEGMONOUS ERYSIPELAS OF THE LARYNX. ('Treatise,' p. 73, Plate II.)

THOMAS BANT,* a stout man, aged 67, had his leg broken by the kick of a cow, on the 22nd of December, 1834; he was immediately admitted into the Birmingham Hospital, under the care of Mr. HODGSON, and in five weeks the bones were nearly united. From the 2nd of February to the 6th, he felt generally indisposed, fancying he had caught a slight cold from having worn damp clothes, but he made no particular complaint to his medical attendant. On the 6th, he had shiverings and complained of lowness of spirits, weariness, pains in the loins, headache, and of slight soreness of the throat without any difficulty of swallowing. 7th. The throat is more painful and the fauces are found on examination to be a little inflamed. 9th. He complains more of his throat; the tonsils are tumid and red, presenting the appearance of cynanche tonsillaris. 10th. Considerable enlargement of the right tonsil, without any appearance of ulceration; difficulty of deglutition, but none of articulation; no thirst, appetite moderate, urine plentiful; some anxiety and pallor of the countenance. 11th. Tonsils much less tumefied, deglutition easier; his spirits are better; ate meat for his dinner; no cough, pulse frequent and small. In the evening he drank some wine and water without much effort, and his voice was quite natural. In the middle of the night he awoke suddenly, and could scarcely get his breath; exclaimed with difficulty that he was choked, and died in less than ten minutes.

Dissection, Thirty-four Hours after Death.—The throat was first examined. There was extensive deposition of pus in the cellular structure beneath the mucous membrane of the epiglottis, on its anterior surface and upper border (Plate II.).

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* W. B.'s 'Case Book,' Vol. ii., p. 158.

The pus was infiltrated through the sub-mucous tissue, and not formed into abscess. When cut into, this part resembled accurately the sloughy and puriform condition of the cellular tissue of the extremities, in cases of phlegmonous erysipelas. The pus extended outside the larynx between this organ and the pharynx, and the mucous membrane covering the right arytenoid cartilage was in a state of slough; the ventricles of the larynx and the rima glottidis were scarcely perceptible, owing to the very œdematous state of the sub-mucous cellular structure. The laryngeal mucous membrane was of a red mottled appearance, and covered with a thick coat of tenacious mucus. The trachea and bronchi were of a vivid red; they contained very little secretion. The lungs were much congested with dark blood, which flowed out in great quantities when they were cut into. The other viscera were healthy.

[My friend, Mr. W. Bowman, house-pupil at the Birmingham Hospital, to whom I am indebted for this and the succeeding case, and for the drawings by which they are illustrated, remarks at the conclusion of the narration, "there was no case of erysipelas in the ward where this man lay at the time of his attack, but the disease was very prevalent in the hospital. For a year before it broke out, there were no cases of this affection of the larynx, and there have been none since the hospital has been free from that scourge, which is now more than six months."—*Ryland.*]

Case.—Erysipelatous Laryngitis. ('Treatise,' p. 74, Plate III.)

October 30th, 1834. Susan Thomas,* aged 46, was admitted, on account of a fractured arm, into the General Hospital, Birmingham, under the care of Mr. Hodgson. At this time erysipelas was exceedingly prevalent in the wards of this institution. The fracture did well, but at the end of the fifth week she was seized with sore throat, accompanied by typhoid symptoms; she had great difficulty of breathing, and died on the third day from suffocation.

Dissection.—The fauces were inflamed (see Plate III.); the epiglottis was swollen and inflamed, with extensive deposition of pus beneath its mucous membrane and in the adjacent cellular structure at the root of the tongue; between the larynx and pharynx the cellular tissue was in a sloughy state, whilst the contiguous mucous surfaces presented patches of a vivid red. The inflammatory appearances did not extend down the trachea or œsophagus.

[The evidence afforded by the cases which have just been related is, I conceive, conclusive as to the existence of an erysipelatous form of laryngitis from an extension of the morbid action present in the face along the continuous mucous surfaces of the mouth, fauces, and pharynx, to the larynx; and also of another form or modification of the same affection, in which, the fauces being attacked by erysipelatous inflammation, the disease may spread to the larynx, producing disorganisation and death, without the presence of any external erysipelas. It must have occurred to almost every surgeon to have witnessed erysipelas spread from the face to the fauces, producing pain and redness in that situation, with difficulty of swallowing; though an extension of the morbid action to the larynx, I am inclined to think, is rather uncommon. The silence of most writers on erysipelas as to this point must be admitted as evidence of the rarity of the complication in question, for its fatal nature, when it does happen, would insure it from passing quite unnoticed. Dr. Gibson, in the third volume of the 'Transactions of the Edinburgh Medico-Chirurgical Society,' describing the epidemic erysipelas at Montrose, in 1828, says "Sometimes the internal fauces were attacked; and if it spread to the trachea it generally proved fatal." In the following case that fell under my own observation, I have reason to believe the larynx was implicated, though the recovery of the patient still leaves it, in some measure, doubtful.—*Ryland.*]

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* W. B.'s 'Case Book,' Vol. ii., p. 97.

Case.—Laryngitis, from Swallowing Boiling Coffee—Recovery. ('Treatise,' p. 264.)

Eliz. Thomson,* a healthy child, aged 4, swallowed some boiling coffee from the mouth of a kettle, about five o'clock in the evening of the 27th of March, 1837. Half an hour afterwards, when she was taken to the Birmingham General Hospital, the respiration was unaffected, but the voice was rather hoarse. On examining the mouth, the uvula was observed to be swollen, but the other parts were natural.

At six o'clock, the child was restless and cried frequently; the respiration was sonorous; the tongue and pharynx were swollen—the latter considerably—and covered with white flakes, probably the scalded epithelium. Ordered to take two grains of calomel every two hours, and to have the outside of the neck blistered with acetum lyttæ.

At eight, the respiration was croupy; the child dozed at intervals, with great restlessness at other times. A teaspoonful of syrup of poppies was ordered to be taken with each powder. About two o'clock in the morning she had become worse, and her breath was drawn with so much difficulty that the mother thought she was dying. Vomiting took place soon after, and the child was immediately relieved. She vomited several times during the night, and was very restless.

28th, nine o'clock a.m. Respiration raucous, sixty-six in a minute; pulse 160, small and irregular; lips bluish. Has taken sixteen grains of calomel. Mouth and nostrils inflamed. At noon the breathing was still sonorous, but did not betray any symptoms of being obstructed.

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* W. B.'s 'Case Book,' Vol. iv., p. 11.

29th. The child slept much yesterday and was restless at night. The respiration is now fifty-six, with a feeble croupy sound during the act of inspiration. She continues drowsy, has vomited repeatedly, and on the last occasion ejected a lumbricus. The speech is improved.

30th. The respiration is thirty-six and perfectly free. From this time the little patient gradually recovered without any occurrence worthy of remark.

CASE.—LARYNGITIS WITH EFFUSION OF LYMPH, CAUSED BY THE INHALATION OF FLAME

(‘Treatise,’ p. 274, Plate IV.)

[*Injury of the Larynx from the Inhalation of Flame?*—I propose the heading of this section with considerable hesitation, because I have been unable to find any mention of the inhalation of flame as a cause of injury to the larynx, either in works upon the subject of burns or of diseases of the larynx. I shall confine myself, therefore, to the recording of one or two observations of an inflamed state of the larynx and trachea which seemed to have had its source in the breathing of flame, or at least of intensely heated air. It is right to state that the morbid appearances discovered in these cases after death were by no means anticipated, and that the symptoms during life were those of severe bronchitis, without any of that peculiar dyspnœa that results from an obstructed condition of the laryngeal aperture.—*Ryland.*]

Ward 14.—Dreadful Burn—Immediate symptoms of inflammation of the air passages. Death in 3 days. Sectio cadav.—False membrane investing the larynx and upper part of the trachea. Intense vascularity of the mucous membrane. 20th March, 1836.

MATILDA SMITH, aged 18,* was burnt in a dreadful manner over the whole body, but especially on the face and neck. All her clothes were burnt, and she was enveloped in flame for some minutes. She was brought to the Birmingham Hospital immediately, and died on the fourth day with symptoms of bronchitis. The larynx was examined, and the following appearances presented themselves:—There was scarcely any tumefaction of the parts. The epiglottis, the cavity of the larynx, and the upper part of the trachea, were invested with a thin uniform coating of lymph, not organised, and only very slightly adherent to the mucous membrane. (Plate IV.) Its thickness was greatest on the epiglottis, and progressively diminished downwards. The membrane beneath was intensely red or deep purple, but was not much altered in consistence. The mucous membrane of the trachea and larger bronchial tubes was highly vascular.

[For this case I am indebted to Mr. BOWMAN, house-pupil at the Hospital. A short time afterwards the same gentleman sent me a larynx for examination which had been taken from the body of a girl seventeen years old. She was brought to the Hospital very much burnt about the body and neck, and died with symptoms of acute bronchitis on the fifth day from the receipt of the injury.

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* W. B.'s ‘Case Book,’ Vol. ii., p. 323. Index, “Larynx scorched by flame.”

The mucous membrane of the edges of the epiglottis, the internal surface of the larynx, and the upper part of the trachea, were of a cherry-red colour, extremely vascular, pulpy, and rather thickened. The thyro-arytenoid ligaments and muscles were exposed, in consequence of the destruction of the mucous membrane in these situations; the membrane investing the internal surface of the arytenoid cartilages was excessively red, and had a granular appearance as if it had been deprived of its epithelium by the action of fire; the internal angles of both arytenoid cartilages were exposed and sloughy. The area of the larynx generally, and of the rima, was not diminished to such a degree as would occasion any obstruction to the passage of the air. There was a thick mucous secretion over the whole lining membrane of the larynx and trachea.

Soon after the occurrence of this last case I had the opportunity of examining the larynx and trachea of two children who were lying dead at the same time in one of the public institutions of this town. Both of them had died within twenty-four hours after the receipt of severe burns from their clothes catching fire. One of them, a boy about four years old, was much burnt about the face, neck, and chest; the inner surface of the lips was also injured by the flame. The whole lining membrane of the larynx and trachea, and particularly the posterior part of the latter, were intensely red and very much injected; there was no thickening or pulpiness about the membrane. The trachea was filled with thick mucus. The pharynx was also of a vivid red, the colour terminating abruptly at the commencement of the œsophagus.

The other child, a girl about twelve years of age, was burnt on the chest, body, and thighs, but not on the neck or face. The larynx and trachea were congested but not inflamed; the colour of these parts was of a dull violet tinge, which was owing to the repleted condition of the venous system of the sub-mucous tissue. The vessels of the surface of the membrane were not injected, the membrane itself was of a healthy consistence, and there was no mucus in the larynx or trachea.

The subjects of the three first observations were all very much burnt about the face and neck, and it is, therefore, certain that they must have inhaled air at a very high temperature, if not actual flame; they appeared to be suffering before death from acute bronchitis. On a post-mortem examination the superior parts of the air-passages presented marks of acute inflammation, but of different characters. In the instance of Matilda Smith the mucous membrane of the larynx and trachea was of a deep purple colour, and covered with a layer of coagulable lymph. In the subject of the second observation the same membrane was highly inflamed, with loss of substance over the internal angles of the arytenoid cartilages and the thyro-arytenoid ligaments and muscles; the parts, be it observed, with which the heated air would come into closest contact, on account of the narrowness of the larynx at these points.

Whether the loss of substance was produced by ulceration or by the previous detachment of sloughs in these situations, it was impossible to determine. The larynx of the little boy exhibited the appearances of incipient acute inflammation, but the time that elapsed between the occurrence of the accident and his death had been so short that, besides extreme injection of the vessels of the mucous membrane, no other result of inflammatory action was observable.—*Ryland.*]

DESCRIPTION OF THE PLATES.

Plate I.—Œdema of the Glottis with Glanders (Exterior View). (Case, p. 25.)

The mucous membrane lining the cavity of the larynx is seen raised by the infiltration of the submucous tissue. The posterior or pharyngeal surface of the larynx is also affected by the same disease.

Plate I*a*.—The Same, laid open (p. 26).

Showing the orifices in the mucous membrane, with pus escaping. This is from a drawing not introduced in Ryland's work.

Plate II.—Erysipelatous Laryngitis. (Case, p. 27.)

Great tumefaction of the edges of the epiglottis, and the lips of the glottis exists; incisions have been made into these parts to show the infiltration of pus and the sloughy and puriform condition of the submucous cellular structure. The whole mucous membrane of the larynx and trachea is highly inflamed.

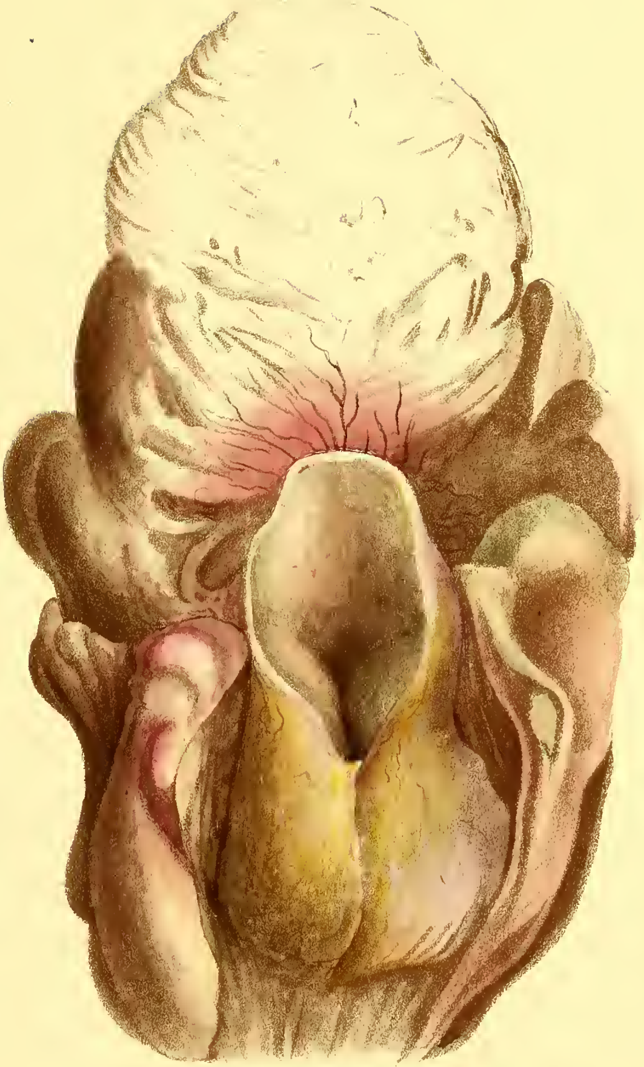
Plate III.—Erysipelatous Laryngitis. (Case, p. 28.)

This plate represents a slighter degree of the same disease than the preceding. The pharynx and the root of the tongue are intensely inflamed. The edges of the epiglottis are thickened and infiltrated with pus. There are no inflammatory appearances below the rima.

Plate IV.—Laryngitis with Effusion of Lymph, caused by the Inhalation of Flame. (Case, p. 30.)

The lymph is seen effused over the internal surface of the epiglottis, the larynx, and the upper part of the trachea. The membrane beneath the lymph is vividly injected.

Plate I



Drawn by H. Power

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Plate I a

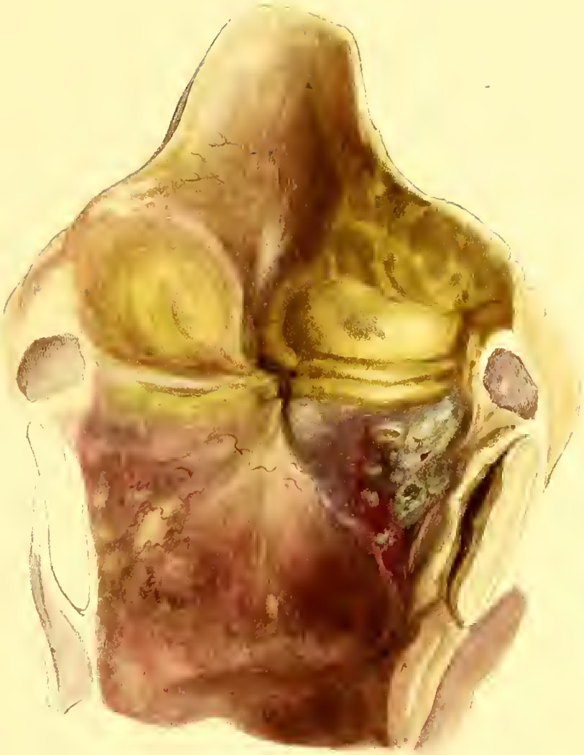

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Plate II

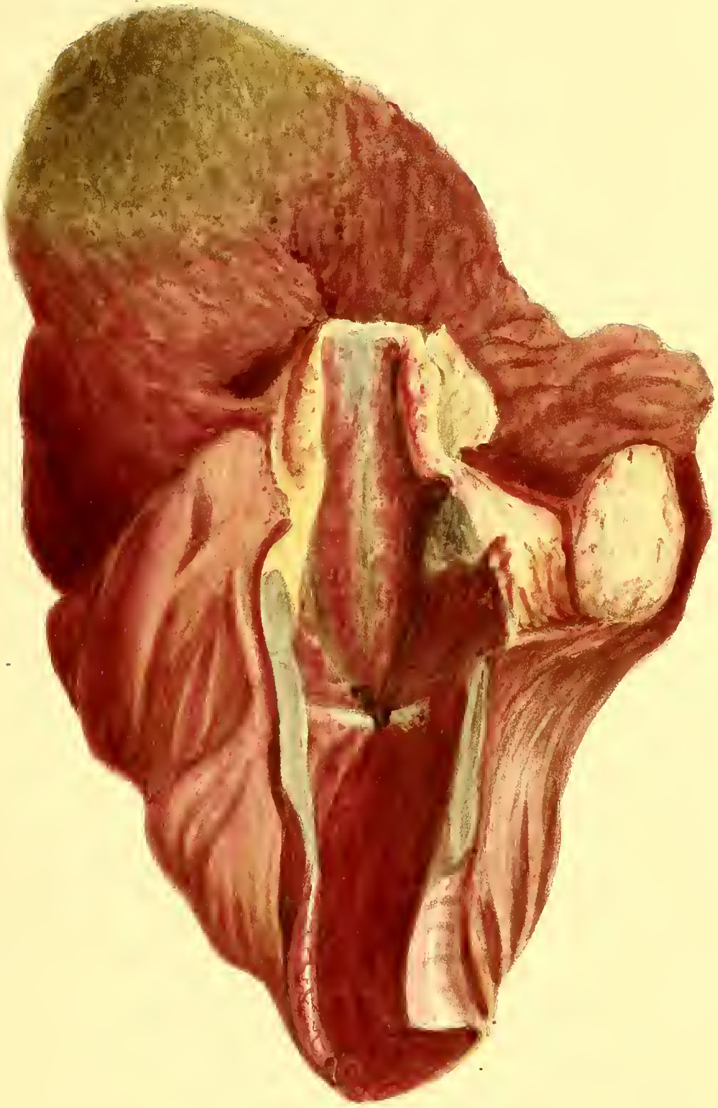

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Plate III.

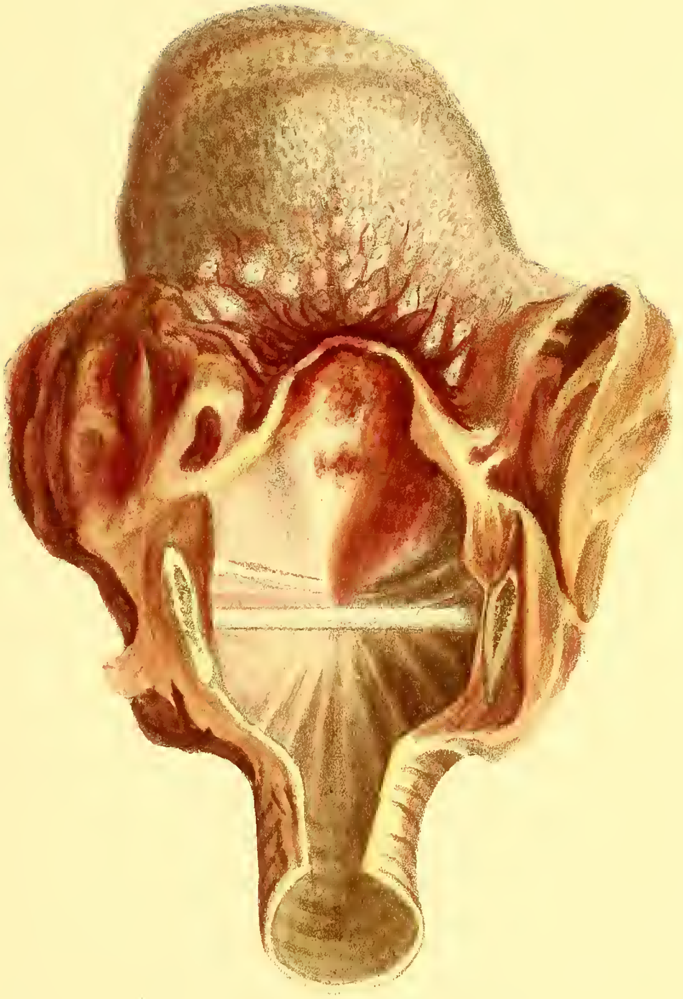

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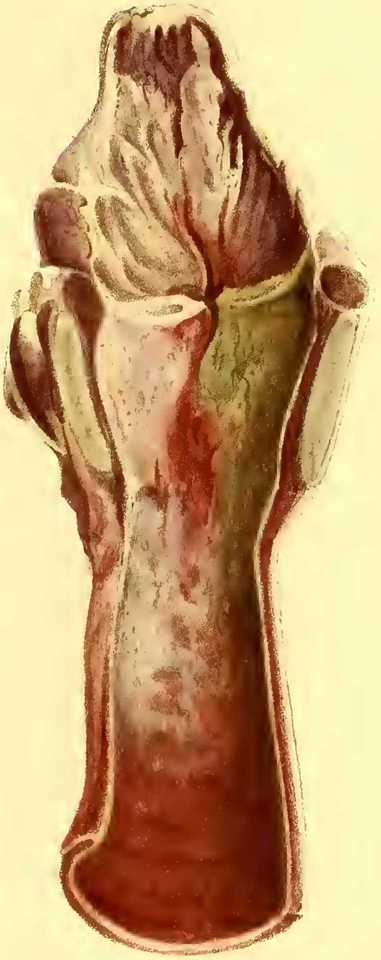
Plate IV.



Drawn by W. Bowman

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V.

OBSERVATIONS ON THE MINUTE ANATOMY OF FATTY DEGENERATION OF THE LIVER.

By WILLIAM BOWMAN, *Esq., F.R.S., Demonstrator of Anatomy in King's College, London; and Assistant-Surgeon to King's College Hospital.*

From '*The Lancet,*' *January* 22*nd*, 1842, *pp.* 560 *and* 561.

FATTY degeneration of the liver is found almost exclusively in phthisical subjects. LOUIS met with it in forty out of one hundred and twenty cases. The organ is always enlarged in a degree proportioned, *cæteris paribus*, to the quantity of fat it contains. It is altered to a buff colour, resembling that of fallen leaves. In consistence it is nearly natural; and when sliced the knife is rendered greasy, and minute globules of fat appear, mingled with the blood. It has also an unctuous feel, greases paper, and readily inflames. This deposit of fat is never collected into masses, but is equally diffused throughout the whole viscus. It is remarkable that it occasions no obstruction to the portal circulation, as is clear, from its being always unattended with ascites. It never, indeed, gives rise to any symptoms (beyond those of mere enlargement) from which its existence might be suspected during life. Thus much is already known of the disease.

In examining under the microscope, a short time since, a specimen of this disease, taken from the body of a patient of Dr. BUDD in the King's College Hospital, I observed an interesting fact, denoting the seat of the fatty accumulation, which, with Dr. BUDD's concurrence, I am desirous of communicating.

To make clear my meaning, I shall premise a very few words on the minute structure of the lobules of the liver. Mr. KIERNAN has well described the *vascular element* of these minute representatives of the organ. It consists of a capillary plexus intervening between the portal and hepatic veins. The diameter of the capillaries in this plexus is very large, being nearly twice that of a blood globule; while the diameter of the capillaries in most other textures is the same as that of the blood globule, and in some (as muscle) even less, so that the blood globules only pass along by undergoing elongation. This large size of the capillaries of the liver, probably, has reference to the deficiency of propelling power in the portal circulation. This *portal hepatic plexus may be termed solid*, as it is extended in all directions, and presents areolæ of nearly the same dimensions in whatever plane it is cut. These areolæ are in general not larger than the diameter of the vessels which form them, so that a well injected specimen might appear to be composed of little else than vessels.

In the interstices of this capillary plexus lies the *secreting portion of the bile-ducts*. If a thin section of an uninjected lobule be examined with a sufficient magnifying power it is seen to be almost entirely made up of small, irregular angular particles, each containing a circular or oval nucleus, within which is a minute point or two, the nucleolus. These particles have a determinate outline, are of some thickness, and possess a fine granular aspect. They also contain (which is very remarkable) one, two, or more globules of fatty matter irregularly placed, and of somewhat variable bulk, though usually about the size of those represented from the healthy human liver in Fig. 1.

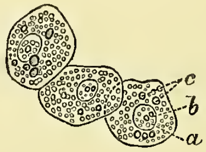

FIG. 1.—NUCLEATED PARTICLES FROM THE HEALTHY HUMAN LIVER.

We owe the first good description of these nucleated particles to HENLE* who (with PURKINJE and SCHWANN) believes that they correspond with the epithelium found in all other true glands, and that they are the proper glandular element, to which the secretion is due. No one who has extensively examined the minute structure of glands can well be of a different opinion, though it must be allowed that we are still ignorant of the precise anatomy of the ultimate ramifications of the biliary ducts. The oily globules found in the nucleated particles appear to have special reference to the chemical nature of the secretion, which contains a large quantity of highly carbonized matters, that are to be regarded, according to Dr. PROUT, as modifications of the *oleaginous principle*. The nucleated particles of the sebaceous glands also contain fat, and in this respect offer a striking analogy with those of the liver.

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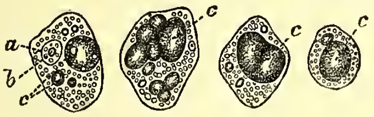
* They have also been examined by other foreign anatomists, as well as British. Mr. ERASMUS WILSON discovered them in 1838, in the liver of the cat, when as yet the works of HENLE were unknown in this country.

The microscope at once reveals the seat of the *fatty deposit in the diseased state of the organ.* Instead of containing a few minute scattered globules, *the nucleated particles are gorged with large masses of it,* which greatly augment their bulk, and more or less obscure their nuclei. (*See* Fig. 2.)

This simple description developes the whole anatomical condition of the disease, as well as explains its rougher characters, the bulk, the colour, and the freedom of the circulation. The particles, lying in the interstices of the capillary plexus, enlarge slowly and equably, in such a manner, as to exert no injurious pressure on the vessels, while their new contents impart that peculiar hue which characterises the disease.

It also throws no little light on the nature and source of the disease. It seems to show that the fat is an *increase of a normal constituent,* and not a formation altogether unnatural in kind; thus distinguishing it from the fatty degenerations of other tissues where fat is deposited in situations from which it is naturally absent. It likewise indicates an increased activity in the secreting action of the liver, for a considerable period before death, though, why the *accumulation* of fat should occur within nucleated particles does not so clearly appear. To explain that fully will require a more complete knowledge than we yet possess of the chemical affinities at play within these small laboratories of nature.



a, a, Nuclei. *b, b,* Nucleoli. *c, c, c,* Fatty globules.

FIG. 2.—NUCLEATED PARTICLES FROM THE LIVER AFFECTED WITH FATTY DEGENERATION.

That the liver should for a length of time be urged to increased activity in phthisis, where the respiratory function is so gradually, yet so enormously, interfered with, is not wonderful, when it is remembered that its chief office is to throw off carbon from the system. This consideration may give a clue to the cause of the disease, or, at least, it may serve as a guide to future inquirers in their investigation of facts. It is singular that this condition of the liver has been observed in only about a third of the whole cases of phthisis, and scarcely at all in other chronic diseases even of the lungs. To what is this to be attributed? It is possible that a less amount of morbid accumulation may have occurred in cases where it has not been recognised. But it will be worth while to inquire, hereafter, in connection with the state of the liver in such cases, what has been the extent and duration of the tubercular disease of the lungs? Whether it has been accompanied and its progress accelerated by complications of inflammation, hæmorrhage, &c., what is the degree of emaciation at the time of death? Whether the process of emaciation has been rapid or slow? And whether the patient previously was corpulent or lean? An attention to these circumstances may possibly explain the apparent difficulty.

I cannot conclude without remarking that the fact which has been detailed is an admirable example of the kind and degree of insight into pathological changes which the microscope is calculated to afford. It is happily unnecessary, in the present day, to come forward as the advocate of this invaluable instrument as an aid to the study of disease. The fact is also of uncommon interest as an illustration of the strict subordination of the study of pathology, as well to that of *minute anatomy* and *minute chemistry*, as to semiology and that coarse inspection of morbid changes which has too long usurped the name of *morbid anatomy*.

VI.

ON THE DISSECTING ROOM, WITH REFERENCE TO THE DISEASES IT OCCASIONS.

Read before the King's College Students' Medical and Scientific Society, Thursday, January 25th, 1838, *Professor* Royle *in the Chair.*[*]

The study of anatomy is intricate and difficult, requiring on the part of the learner long, tedious, and repeated investigations, by dissection, of the structures of organised beings. Their almost endless complication of texture, form, and situation, *require* these at his hands, while the wonderful evidences of beneficence and wisdom they everywhere display, serve powerfully to enchain the attention and engage the heart in the pursuit. For who that reflects for a moment on the astonishing variety and beauty of the actions that are being continually carried on in every corner of his frame, and considers that all depend for their integrity on the utmost delicacy and nicety of the organs that conduct them (for that the smallest disarrangement of any one of these would immediately be followed by a corresponding incompetence for function), can fail to be impressed with a desire to *examine for himself* the machinery of such movements? It is not my intention to stop now to enquire how it happened that this delightful science, the basis of all rational medicine, after having been once cultivated with considerable success, came to be disregarded and despised until a comparatively modern era ; but it may fairly be supposed, that in addition to the sources of that general ignorance, which overlaid, like an incubus, the minds of men during the dark ages, the long neglect of it is attributable in some degree to the very nature of the study itself, as in its prosecution prejudices are roused, disgust excited, and annoyances and danger encountered, that would constantly operate as a check and great discouragement to it. And *these* causes continue, for though the zeal and industry of 200 years have succeeded in withdrawing it from the hands of ignorant pretenders, and given it a distinguished place among the sciences, yet the grossest prejudices concerning it are still harboured by the vulgar—aye, and even by educated persons. It still wears a loathsome aspect to the uninitiated eye; and it still threatens with disease or death those who most strive to cherish and advance it. A short time only has elapsed since arguments were urged upon the attention of the British Parliament by a member of the House of Commons, to prove that dissections were useless, for that anatomy might be taught from models. Sir Anthony Carlisle wrote a letter to the 'Times' with this bright thought; but it must be allowed that the passing of the Anatomy Act abundantly proved that the legislature and the age were too enlightened to be deceived by so great an absurdity. We may congratulate ourselves, therefore, that the reign of this delusion is fast passing away, to be succeeded by a brighter era, when Ignorance, if she still lingers about the portals of Knowledge, will at least cease to obstruct the path of those who would enter into its sacred precincts. And perhaps the anticipations of a time when the *dangers* likewise of dissection will be much diminished or averted, are not entirely visionary. Those who contributed, by their influence or example, to dispel the prejudices of a former day against the dissection of human bodies merit the undissembled gratitude of the Profession and the nation, and *they* will no less deserve it, who are endeavouring at the present time to render the occupation in other respects more attractive and safe.

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[*] See Druitt's 'Surgeon's Vade Mecum,' *circ.* 1844.

My own humble object in advancing the topic in this evening's paper is merely to excite enquiry and attention to the subject among medical students, whose opportunities for observation and reflection are necessarily very ample, and who, being the class most interested and concerned, may be expected to be most earnest, as they indeed appear to be the legitimate and bidden labourers in this field of investigation. The melancholy fact that not a season passes by in this great city without leaving indelibly impressed on our minds the circumstances of sadness with which illness or death, thus occasioned, has visited some of our companions, invests the subject with a peculiar interest, and leads us to regard it in that intimate and personal light, with which men are accustomed to clothe perils, present and imminent to themselves. On this account it would seem not a little remarkable that our literature in this respect is so meagre and deficient; and I can only attribute the circumstance to that carelessness concerning the safety of others that are to follow, which appears almost naturally to grow up in the mind and choke our sympathies, when we are ourselves removed from the source of contamination.

The subject seems naturally to arrange itself in the following order, and to demand that I should first describe what are the ill-effects observed to follow an exposure of the body during a longer or shorter time to the influence of a dissecting-room? Next, that judging from these effects, and from other considerations, I should endeavour to trace the nature and extent of the causes that concur in their production, and the manner in which such causes act in their interference with the processes of health; and lastly, that I should, from a review of both these, attempt to deduce the modes of treatment, prospective or immediate, that may be had recourse to with the greatest expectation of benefit.

When a person enters a dissecting-room for the first time, particularly if his mind has not been prepared beforehand for what is there to meet his eye, the probability is that the impression of disgust will be so powerful as to produce transitory faintness and perhaps vomiting. But when habit has so far blunted the susceptibilities of his mind, as to have rendered him proof against these more delicate influences, his system will be found to suffer in a different manner, and to exhibit a series of phenomena, slow in their advance, and which appear to depend upon physical causes of an accumulative nature. Again, if the constitution of the same person, either from a vice of original conformation, or, as is more frequent, from the action of causes to which it has been lately exposed, be made liable to become the recipient of a morbific animal poison, when such poison, introduced into a wound, is brought into contact with the living surface and absorbed, other trains of symptoms, both local and general, present themselves, of high interest, and sometimes most frightful in their nature, and which offer varieties exceedingly curious, and by no means admitting of an easy explanation. Hence we are led to remark three general modes in which the health may be deranged from this cause—the first, a temporary, and usually an unimportant effect upon the nervous system, conveyed through the medium of the senses; the second, a general disturbance arising from a continued exposure to deleterious influences of a physical nature; and the third (which is, in part at least, a local disease) originating in absolute inoculation.

Interesting as the first of these forms is, in a physiological point of view, as illustrative of the very intimate relation that subsists between the mind and body, yet it has too light a connection with our present subject, and it possesses comparatively too little practical importance to merit more than a passing notice here. It sometimes, though rarely, happens that persons of an irritable and susceptible temperament, or of great refinement of mind, should they be brought unexpectedly to view the (to them) revolting scene exhibited in a dissecting theatre, are so completely unhinged by it that they can never afterwards recall the picture without the deepest disgust. Should this happen to a medical student it is much to be regretted, as unless a strong mental effort on his own part can be made to dispel the impression, he is thereby effectually prevented from studying this all-essential branch of professional knowledge in that practical manner which its great importance demands; and as it is to be feared that the same feeling of aversion or disinclination for anatomy, though in a less degree, is no uncommon consequence of the disagreeable impression thus first made on the mind, never entirely to be erased, all attempts to soften the *repulsiveness* of the dissecting-room become objects of policy with the superiors of the profession and the government, as well as of comfort and safety to the students themselves. With regard to this loathing considered as a predisposing cause of disease, I may mention, before finally dismissing the subject, that in some instances no determination or assiduity in the pursuit will effectually obliterate it; and where the ardour and zeal of the student induce him to smother it as well as he is able, it will nevertheless recur frequently, and will probably have an effect in rendering his system more susceptible of those other forms of disease to which I shall now beg to direct your attention.

The attack of ill-health, which is so common a result of the labours of a session, is usually slow and insidious in its first advance, the powers of the constitution being much undermined before the sanguine student can be induced to allow himself any respite from his health-destroying exertions. He has often found himself at the conclusion of the day unable from headache, drowsiness, and lassitude, to continue at his fireside the labours of the morning, and has often arisen after a weary night unrefreshed and jaded. He has frequently partaken of his meals without relish, and been troubled with flatus and a tendency to diarrhœa, or unusual costiveness; nevertheless, these warnings have passed almost unheeded, and his hopes have deceived him into believing them to be nothing more than some temporary accidental discomfort which called for no attention or concern. They have probably from time to time left him an interval to rally, and he is thus lulled into a feeling of security most baneful in its future effects, which whispers that he may without danger continue the pursuit that ought now at once to be abandoned. If the pulse be examined about this time, it may be found soft, wavering, and unsteady, ranging perhaps between 60 and 100, and often varying considerably in frequency, even in the course of a few beats. Faint and irregular flushings of the features may be detected, while the countenance is gradually assuming a paleness that is unnatural to it. Animal heat is generated in less abundance and with less uniformity as to time, and there appears to exist a diminution of the power of resisting external cold. Hence the cutaneous exhalation is interfered with, it is sometimes suppressed, while at others it breaks out profusely in particular regions; and it exhibits besides some other rather singular phenomena, which will be afterwards adverted to.

This first stage then begins to merge into the second, and some decided evidence of grave indisposition is sure to mark the progress of the complaint. Perhaps diarrhœa is the most common occurrence of all, and hence it has been facetiously regarded as the unerring test of assiduity on the pupil's part. It is ordinarily of brief continuance, and tractable enough by proper remedies, but occasionally it is more severe and obstinate, putting on all the characters of dysenteric fever. The evacuations are usually remarkable for their fætor, and in these latter cases are tinged by blood. Lowness, debility, and inaptitude for exertion accompany the attack, and I have known jaundice to supervene without a manifest cause. Sickness and anorexia are also present, and the general symptoms before mentioned are more or less aggravated. Sudden faintness is often the first token of danger, and is interesting as marking the very depressed state of the nervous system at this period of the disorder. It sometimes happens that, while the functions of the intestines are less prominently deranged, the stomach and the biliary system become the chief sufferers. This form will be very likely to occur in subjects previously dyspeptic; disagreeable eructations and nauseous secretions, not only from the stomach, but from the mucous surface of the mouth and fauces, will prove excessively annoying to the patient, and will aid in depriving him of all appetite or relish for food. *Jaundice* is more apt to become connected with this variety. It may run its whole course without at all modifying the other symptoms, and, *usually*, its *onset* is attended with but little aggravation of them. In one remarkable case which I had an opportunity of observing closely, the jaundice was followed after some days by a dull, heavy pain in the hypochondrium (slightly increased on firm pressure), and likewise by fulness of that region, the signs of sanguineous repletion. There are also great depression of spirits, a costive state of the bowels, and a copious extrication of gas, which, like the evacuations, is possessed of an abominable odour. The stools are clay-coloured, plastic, and consistent. Chills, alternating with slight febrile exacerbations, and a small, slow, yet excitable pulse will likewise be observed, and in both these forms the secretions from the skin will be sensibly disordered.

Lastly, when the contaminating causes have been unusually severe or long applied, fever of the worst kind may develop itself, and undoubtedly this, considered in itself, is the most formidable of all this class of affections. But, owing to the cleanliness and good ventilation of most dissecting-rooms at the present day, the instances of it are exceedingly rare, and, as its phenomena are not, I believe, dissimilar from those of putrid fevers in general, I shall not stop to describe them.

The disorders whose lineaments I have now attempted very hastily to scan, may be regarded perhaps as the principal of those which come under the second head; but they are so liable to variety from the age, predisposition, and amount of exposure of the individual, as well as from numerous other circumstances, that it were an endless and a fruitless task (if I were capable of it) to trace them through their remoter shades. This, however, is certain, that the occupation which deprives one man of his relish for food, marvellously increases the appetite of another, verifying the old adage "What's one man's meat is another man's poison." JOSHUA BROOKES dissected summer as well as winter. On the other hand, persons with a predisposition to certain diseases, particularly such as are induced by debility, would do well to regard with suspicion the first encroachments of the affections I have sketched, as little doubt can be entertained of their power to turn the scale against them. The development of phthisis in particular may be thus determined or accelerated.

The *wounds received during dissection* come next to be considered, and this part of our subject has received somewhat more attention from surgical writers than any of the others. The severer forms of the diseases consequent on inoculation are indeed so appalling in their aspect, and in their course so rapidly mortal, that it would be strange, indeed, if they had not arrested the peculiar attention of the profession. Nevertheless, there seems to be no work exclusively devoted to them in the English language, and the passing allusions to them, occasionally stumbled upon in general treatises, are rather unsatisfactory. Mr. Colles, Dr. Duncan, and Mr. Travers, however, and in particular the latter gentleman, deserve the thanks of the student for their able attempts to elucidate them. I regret being able to offer only a very brief notice of them.

When morbific matter is inserted into a breach of surface of the skin, there is a chance of its producing the most serious interruption to the functions of life. I say "a chance," for in the majority of instances no injurious effect is observed to follow the inoculation, a circumstance to be attributed partly, if not entirely, to the want of susceptibility in the part or the whole system to receive the morbid impression. It is difficult to determine whether *absolute absorption* occurs where the poison proves innocuous, but it appears most probable that it does, but that it either undergoes some change during the process, or that the healthy condition of the system enables it in some way to resist it and throw it off without contamination, for in many cases where the general symptoms are quite trivial, local ones ensue, and the absorbents and glands are involved. That this susceptibility on the part of the recipient has a most important and essential share in determining the event seems proved by the acknowledged uniformity with which ill-health and nervous debility have been observed to precede the most violent and alarming of these affections. All those causes, in a word, which induce debility, and lessen, as it were, the preservative influence of the vital principle, are to be regarded as powerful predisponents to this, as well as to other diseases of an analogous kind.

It has been already remarked that the great majority of these small skin wounds differ in no respect throughout their progress from such as are inflicted by other means. They soon get well, with or without festering, as the case may be, and with little comparative inconvenience. This general result is in part to be attributed to the care with which they are usually at once cleansed from all foreign matter, and to the other precautionary means commonly resorted to, as causticking their surface, touching them with alum or turpentine, but chiefly, I apprehend, to the healthy state of the system; and hence it is that severe consequences seldom ensue during the early months of the dissecting season. A great variety may also exist in the morbid properties of the matter introduced, though I believe nothing exact is ascertained concerning this particular. It has been said, indeed, that fresh bodies, and such as have lain long in a putrefying condition, communicate more danger when they taint a wound than those that have undergone only a moderate decomposition; and the opinion is very probably substantially correct. Indeed, as far as our enquiries have hitherto extended, it appears to be fully made out, that the most aggravated forms of disease arising from the absorption of this morbid poison have, without exception, originated in the examinations of recent subjects. A very interesting and important question has likewise been discussed, whether the bodies of those who have died from plague, cholera, fevers, erysipelas, puerperal peritonitis, and other contagious disorders, retain the powers of similarly infecting those who handle them or are inoculated with their fluids, after the organic life has once fairly relinquished them, or even *at all*, after apparent death. In some cases, especially of erysipelas, and puerperal peritonitis, this contamination appears most unequivocally to have happened.

The *size* of the wound bears no relation to the amount of mischief that may ensue. Indeed, it may be safely asserted, that it has been from the smallest and most inconsiderable ones that the very worst symptoms have often sprung, because it is not the *quantity* of morbific matter absorbed that is of so much consequence, but whether that matter has been so inserted that it has acted in a concentrated form, and has not been interfered with while being absorbed; and a narrow and deep wound, such as that caused by the puncture of a needle, is more adapted for this purpose than a broad gash that bleeds freely, and thereby washes off the poison and attracts attention. It has been generally supposed that torn and lacerated wounds are more liable to be followed with unfortunate consequences than clean cuts, and probably for the above reason.

The recorded cases of "dissecting wounds" (as far as I have been able to trace them) are not numerous, and, from a want of concurrence among writers in their theoretical notions concerning them, it is difficult to decide with precision what are to be regarded as the best established types amongst the numerous varieties presented. I shall therefore, without any view to classification, attempt a very rough outline of the symptoms, as they have occurred in three forms which happen to have fallen under my own observation, and then advert, with equal brevity, to one other.

In the *first*, the local inflammation is severe, but usually not extensive, if judiciously treated. The constitutional irritation varies much in intensity, but it is never more than the amount of local action may readily account for. The absorbents and glands are often slightly and temporarily implicated, but always subsequently to the local inflammation, and evidently depending upon it. One of the latter may undergo suppuration. It is doubtful whether this form be produced by the absorption of morbific matter. Its phenomena admit of explanation on the ground of simple irritation.

In the *next form*, either the local or general symptoms may be the first to manifest themselves, and the latter commonly have so much severity, and are also so peculiar in their nature, that it is difficult to suppose them the mere consequence of the former. The two, besides, bear a very uncertain proportion to one another. It is most usual for the punctured finger to be slightly inflamed towards the second day, and very painful; but occasionally the scratch excites no uneasiness, and is entirely overlooked by the patient for some time, though it uniformly suppurates sooner or later. The absorbents are generally inflamed, but often the deep ones alone are affected, and then they escape observation. The glands of the axilla, however, attract our particular attention. They are always implicated, and usually suppurate, constituting the ordinary axillary abscess of students. It is very common for the patient to be awakened in the night by the most excruciating pains about the shoulder, extending down the arm, where they have a pulsative character, and are much increased by hanging the limb. The least motion of the part is intolerable. A single gland, or a cluster of them with the cellular membrane in which they are imbedded, is swollen and excessively tender. Remedies seldom afford relief, and even opiates often prove unavailing. The constitutional symptoms are of concomitant severity, and even take the lead. Rigors, sickness, furred and clammy tongue, rapid pulse, but above all a most remarkable prostration of strength and depression of spirits supervene, with occasional delirium, and they only subside when suppuration is established and the matter gains a free outlet. A considerable interval always elapses before health is completely restored. It is the opinion of Mr. Travers that all these symptoms are to be accounted for, without supposing the absorption of a poison; but, notwithstanding so high an authority, I know the opposite is maintained by many surgeons, on perhaps not insufficient grounds.

The *third form* is a very fearful one, and happily is rarely met with in practice. It derives its horror from the frightful rapidity and certainty with which it runs its course, forty hours being sometimes sufficient to terminate existence. Several distinguished professional gentlemen have fallen victims to it in the prime of life and usefulness, amongst others, Professor Dease, Mr. Shekelton, and Dr. Darwall—a fact which serves painfully to enforce the importance of a study of it upon all of us. But hitherto we cannot help confessing that it has been known only to be dreaded. No remedy for it has been effectual: none has even been suggested that gave a prospect of benefit. The proof of the absorption of a morbific poison is here most clear and unequivocal, and no difference of opinion prevails concerning it. Commonly the puncture is attended in the first instance with severe local pain, which does not cease; but in some cases the prick is so trivial in extent and inconvenience that it is entirely overlooked. Then, generally in the middle of the night following the infliction of the wound, the patient having retired in apparent health, is roused semi-delirious, and suffering the most exquisite torment. It is described by him as of a most intolerable kind, and surpassing all that he had ever conceived possible. He exclaims "that he would rather have his limbs amputated one by one than longer endure such anguish." (This was the expression of Mr. Shekelton.) The pain is at the tip of the shoulder and in the region of the clavicle, and little or no swelling is at first apparent. The countenance is wild and anxious; the limbs tremble; there is great prostration; the tongue is brown; rigors probably occur with vomiting, and the pulse is rapid and feeble. Under the intensity of this fearful shock, the patient may succumb; in which case the local changes that are met with are perfectly inconsiderable; but dissolution is seldom so rapid—a diffused, puffy swelling, excessively tender, begins to appear above the clavicle and in the axilla; it spreads over the whole side of the trunk; it becomes covered in parts with a transient redness, perfectly distinct from the red blush of erysipelas; and if cut into, an amber-coloured effusion of serum is found occupying the structures subjacent to the skin; and should life be prolonged for a fortnight or three weeks, as sometimes happens, a slow indolent suppuration is found to have ensued. The opposite arm, too, or probably some other part equally distant from the original seat of the disorder, will soon be found to present patches, similar to those described, and one or more of the joints may become the site of a morbid effusion with extreme pain. But during the progress of these several processes a very interesting circumstance may have occurred, which has been regarded by some as diagnostic of a specific form of the affection. I allude to the formation of one or more vesicles of a very peculiar appearance, at the point of the original puncture, or even in distant situations. They contain a fluid of milky whiteness and consistence, but are not connected with any deep-seated changes. Meanwhile the general symptoms have assumed more decidedly a typhoid type, and in this manner the patient sinks. Many of the phenomena of this severe form bear a very strong resemblance to the secondary effects of phlebitis, as was some years ago remarked by Professor ARNOTT, but I am not aware that any observer has actually examined into the state of the venous trunks subsequently to that time.

It sometimes has been observed that the disease arising from inoculation has taken on a chronic character, and it then bears considerable resemblance to the chronic effects of some other morbific animal poisons, such as glanders for example. The local inflammation which ensued on the receipt of the injury having subsided, the system refuses to rally, and during a period more or less prolonged, patches of indolent inflammation continue to appear at intervals in the neighbourhood (principally in the joints), and even in distant parts. They show little or no disposition to suppurate, and in external aspect are said to be very like the *erythema nodosum*. Their constitutional origin is proved by their yielding to general treatment alone, and country air is found the best remedy. It may happen that this "erratic" form of the affection may appear at once without the intervention of the ordinary inflammation.

We may now extend our view to the causes of all these serious diseases, and we shall probably find them to be more numerous than a cursory inspection might lead us to imagine. As they affect the anatomical student, they appear to admit of reduction under three heads, viz.:—

1st. The sedentary nature of his pursuit;

2nd. The anxiety of mind frequently accompanying it; and

3rd. The direct action of a poisonous agent upon the body. But as the two first are of an obvious character, and bear a less immediate relation to the object of the present paper, I propose to pass at once to the consideration of that last enumerated. And first, of the *nature* of these injurious agents.

Subjects may be regarded as deleterious from two causes. First, from their emitting, for a short time after death, effluvia which are dependent in some measure for their properties, on the peculiar state of the individual during the last days of life. Thus, contagious diseases have sometimes been found capable of being propagated by contact with the bodies of patients after their death; but common experience must have been sufficient to convince everyone whose opportunities of observation have been at all extensive, that there is occasionally a greater difference in the amount and kind of effluvia evolved than can be accounted for on this principle. The sickly odour thus exhaled is often more offensive than the more decided stench of advanced putridity, and instances have been known in which this effect has been so remarkable that more than one person accustomed to dissection have fainted at the first impression. It seems very probable, however, that this has been produced more by pulmonary absorption than by the sense of smell. It is also by no means unlikely that inoculation from such subjects would be attended with more dangerous consequences than ordinary punctures, though I am not aware that any connection has been ascertained to exist between this peculiar odour and the worst cases of dissecting wounds. It is to determine facts of this nature that the observations of students might advantageously be directed. It is a question of great difficulty how far the power of infection thus existing for a short time has relation to the remnants of organic life; and whether it ceases to be exerted after these are altogether extinguished? Whether also morbid poisons, as the smallpox virus, are capable of communicating the disease, when passed from the dead to the living? These topics, however interesting, time does not allow me to discuss.

2ndly. Subjects may be deleterious from decomposition. It has been already stated that the most aggravated forms of disease resulting from these wounds are those at *post-mortem* examinations, and where the subjects are very recent; but where decomposition is advanced, wounds may still be tainted; and examples of this fact are very frequent amongst students. It is also to this form of morbid influence that the declension of the general health already described is chiefly to be attributed. The products of decomposition affecting the human body exist under two forms; either as gases, or in a state of semi-fluidity. Both vary much in quantity as well as quality, according to the stage of the process in which they are generated, and the rapidity of their formation will be principally determined by the degree of atmospheric heat and moisture. The gases, according to chemical analysis, consist chiefly of sulphuretted and phosphoretted hydrogen, ammoniacal and carbonic acid gases, together with others of minor importance, mingled with them in small proportions. Of these, carburetted hydrogen is occasionally a rather abundant product. The poisonous properties of these gases in their concentrated forms are sufficiently established: and no reasonable doubt can be entertained that they exert the same kind of injurious power when in the vastly diluted state under which they here present themselves to our notice. It is alleged by **Dupuytren** and **Thenard** that one part of sulphuretted hydrogen, which is one of the most voluminous of these products, when diffused through 1,500 parts of air is instantly fatal to a small bird; and hence we may form some idea of the *amount* of mal-influence to which we expose ourselves in the prosecution of our favourite pursuit.

It is obviously an impossible thing in the present state of our knowledge, to enumerate the almost infinite variety of changes which the several fluids and soft solids of the body respectively undergo from the incipient to the advanced stages of decay. But it seems highly probable, not only that the same structure at different times, but that different tissues at the same period, will go through very dissimilar forms of putrefaction, and will evolve compounds varying much in the agency they are capable of exerting upon the human body; and may not this consideration in some measure serve to explain the incongruous results we are in the habit of witnessing from scratches and punctures? For example, it seems to be an opinion, resting on the experience of many, that wounds received in the dissection of *ligaments*, are more dangerous than such as are contracted whilst handling softer structures. The fact may be correctly appreciated, and it seems hence to receive an explanation. It is remarkable that the "erratic" form generally flows from this source.

The *extent* to which these causes act will be determined by several circumstances, shortly to be considered under the head of "treatment."

One of the most interesting questions connected with our subject is this: How come these destructive agents to gain admission to the body, and in what manner do they act (when introduced) in interfering with the processes of health? A knowledge of this is pre-requisite to the adoption of a rational and scientific treatment. We can readily understand how it is that a morbific fluid is absorbed when placed directly in contact with an abraded surface—the veins and lymphatics are probably both involved in the operation—and thus the circulation is at once contaminated. Now, without this abrasion — with the cuticle entire—absorption both of liquids and gases, is still effected. I believe it to be now an admitted doctrine among physiologists that such an absorption by the skin may and does take place in a state of health, and this being the case, analogy will easily transfer the phenomena to conditions of disease. This view is likewise sustained by experiment and common observation. An eminent anatomist, whose name I now forget, once shut himself up in a small apartment with a subject far advanced in putrescency; having a contrivance by which he was enabled to breathe pure air from without. In the course of half-an-hour his breath became tainted by the products of putrefaction: thus proving an absorption through the skin. It is a fact commonly remarked, that the peculiar odour of the subject will speedily return to the hands, after it has been once effectually removed by washing, which seems scarcely to allow of any other explanation than this: for it reappears at those parts in particular which have been covered with the offensive particles. I have often thought this a very interesting phenomenon, as it seems to show, either that morbid matter is retained for some period in the textures through which it passes to enter the system, or that such textures become in some manner peculiarly active in its elimination. Another proof of the actual absorption of deleterious gases and morbific matter under ordinary circumstances, consists in the frequency with which the liberation of offensive flatus in the stomach and intestinal tube is remarked to follow a morning's dissecting. Many have observed the identity in smell of this flatus with the gases emitted by animal putridity. The fluid secretions of the mouth are not unusually tainted in a similar manner, and I heard a gentleman remark the other day that he had specially recognised a taste under these circumstances, which he could clearly perceive to be analogous to the smell of the dissecting-room. The following case is curious:—A gentleman, after diligent attendance in a dissecting theatre during the greater part of the day, went home into the country. He there found so strong an odour clinging to him, or rather issuing from his body, and he felt so poorly that he took the trouble of changing every article of dress, even to his flannel waistcoat, and underwent a thorough washing with warm water. He still, however, was drowsy, listless, and indisposed, and in a very short time the same peculiar effluvia became again perceptible, and drove him summarily from the drawing room. He perspired freely that night, and was glad to find himself next morning well and *sweet.* There is no reason to doubt that those mucous membranes to which the gases floating in the atmosphere gain access absorb them readily; and as there is here no cuticle to obstruct their ingress, the process will be rapid. The pulmonary mucous surface will be of course the most important of these, but that of the eyes and nose will take a share. It is very common for the eyes to smart when exposed to the effluvia of a bad subject. It is very likely, also, that some absorption may be effected by the mucous membrane of the stomach, from air carried down by deglutition, as MAJENDIE has observed commonly to occur.

The facts that have been advanced tend to prove that the morbid agencies in question undergo no very great modification even of their sensible properties by entering or traversing the system; that they are carried into the circulation, and thereby diffused through every part, that they are usually eliminated (if the powers are equal to it) in much the same state as they entered the body; and that the chief organs by which their injection is accomplished are the skin and the gastro-pulmonary mucous membrane.

In conclusion, gentlemen, it remains that we should devote a small portion of our time to a consideration of the treatment; but that the prescribed limits may not be encroached upon, I shall refrain from dwelling upon all points of it. I shall dismiss entirely that of dissecting wounds, and almost confine my observations to that which may be termed "Prophylactic," since it is more important that we should make ourselves acquainted with the principles of this, and sift them to the bottom.

Everything seems here resolvable into this one rule; that we ought to guard against the absorption of morbific matters, and the consequence of such absorption. And this is to be effected, first, by avoiding exposure to them as much as possible, and secondly, by fortifying the system to resist their influence when absorbed. In pursuit of the first object cleanliness must be the student's motto. The clothes must be kept rigorously free from all impurities, and the person also, as far as is compatible with the nature of the pursuit. The hands must be washed thoroughly whenever the occupation is intermitted, and the linen changed more frequently than would otherwise be deemed necessary. I do not mean that we are to dissect on tip-toe, and at arm's length, taking more heed of our aprons than our heads; but I do mean that we should for our own safety as well as comfort, avoid that extremity of dirtiness in which some dissectors seem to fancy the secret of a knowledge of anatomy to lie; and I feel convinced that the science will be prosecuted with more pleasure and profit in proportion as this circumstance is attended to. To this end the forceps perhaps might be used more constantly than they are. It is plainly to the student's interest that the public prejudice against dissection should be softened as much as is possible; and probably no means will be found so efficacious for this purpose, as the habit of conducting dissections and *post mortem* examinations in private houses with nicety and neatness. I have more than once known permission for a *post mortem* examination that had been pertinaciously withheld, at once granted, when it was known that it was to be conducted by a gentleman distinguished for his care in this respect.

Thus far it is in the student's own power to diminish his danger; for a number of other precautions he will have to trust to the tender care of his superiors. These have reference to the arrangement and management of the dissecting-rooms, their ventilation, and their other resources for dispersing the noxious products, and in all these particulars the rooms attached to this college are scarcely to be surpassed. The student, I think, is more indebted to these precautions than at first sight he appears to be, and it may not be too much to allege that the marked immunity under which the pupils of this school have seemed to lie from the ill consequences of dissecting, is in no small degree to be referred to this cause.

2ndly. By fortifying the system to resist their influence. During a dissecting season in a large town it will be hardly safe to neglect a somewhat generous diet with a glass or two of wine or malt liquor daily, and, above all, exercise in the open air must be religiously taken. Anxiety should be dismissed from the mind as much as possible, and hard study should not be persisted in if the health be found declining. Regular hours should be kept, orderly habits and a cheerful temper cultivated, and last but not least, the bowels should be kept open.

VII.

THOUGHTS FOR THE MEDICAL STUDENT.

An Introductory Address delivered at King's College, London, October 1*st*, 1851, *on occasion of the Opening of the Twentieth Session of the Medical Department. By* WILLIAM BOWMAN, *F.R.S., F.R.C.S., Professor of Physiology in the College; Assistant-Surgeon to the King's College Hospital and to the Royal London Ophthalmic Hospital, &c.*

INTRODUCTORY ADDRESS.

WE have come together to-day, gentlemen, professors and students, in accordance with established usage, to inaugurate a new medical session by an introductory address. Such an assembling, in the amphitheatre of King's College, amid the animation and excitement that attend the opening, not only of our own, but of the other departments of this seat of universal education—based as they all are, on the same sacred principle,* and united under a single head—can never lose its interest by repetition.

As professors, we meet each other once more, as colleagues and friends, to prosecute, with fresh zeal, the objects we have so much at heart; and to feel, in the genial influences of the time and place, new inducements to devote a portion of a laborious and anxious professional life—in fulfilment of the high trust committed to us—to the education of the rising generation of medical men.

It *is* animating to *us*, gentlemen, again to see around us many of those faces which the mutual duties of preceding years have gradually made pleasant and familiar to us. They bring to our minds the cheering recollection of well-spent hours, when the kindly interchange of thought and feeling, and a just appreciation of the relations we bear to each other, originated those bonds of friendship that are now, we trust, about to be still further fostered and cemented.

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* Viz., "That every system of general education for the youth of a Christian community ought to comprise instruction in the Christian religion as an indispensable part, without which the acquisition of other branches of knowledge will be conducive neither to the happiness of the individual, nor to the welfare of the State."

We know, too, by our own experience (unless the young men of the present day are differently constituted from those of a former period) that an occasion like this is very interesting to *the student* also; especially to the new-comer, approaching for the first time the portals of the profession—his mind tractable, his heart beating with the hope of a future career of excellence and distinction, and his whole soul overflowing with a sincere desire to know and to practise whatever is right, and most conducive to the end he has in view. I cannot reflect on the position and feelings of the junior student without being sensibly reminded of the responsibility imposed upon me, of addressing a large portion of my remarks to *him*; and I can hardly, perhaps, do better than attempt to give him some notion of the profession he has chosen, of the spirit in which it should be pursued, and of the scope of his obligations to himself and others during the ensuing years of study.

Many of your number, gentlemen, are now seated for the first time, in one of the theatres of this great College, and are but just entering on the yet untried ground of the medical profession. Everything relating to your future studies and your adopted calling, is as yet indistinctly seen by you; for you lack that lengthened experience which alone is able to acquaint you fully with what lies before you. You can hardly yet know what rewards and benefits came within your reach, what serious responsibilities you assumed, what heavy personal sacrifices you certainly became liable to, when you decided on the profession of your choice. It cannot, therefore, but be salutary for you, while pausing for a few moments on the threshold of your labours, to receive from one who has trodden the same path, some trustworthy intimation of what a reasonable survey of the medical profession may warrant you in expecting from it, if you deal fairly by it, and sedulously cultivate its tendencies for good, and follow it with high and noble motives, and in that Christian spirit which is so truly akin to its own. Thus led to draw no fanciful or exaggerated picture of either its excellencies or its difficulties, you will hold on your course with more steadiness of purpose, and with a free and hopeful spirit, stimulated by the honourable desire of securing for yourselves the blessings it is able to yield, and fortified, in some degree, against the peculiar dangers with which it may environ you.

And let me begin by remarking that, however much it may concern the welfare of the community at large, and our profession itself, that the social position of the general body of practitioners should be attempted to be raised—by statutes or charters—to a point befitting the dignity of our calling, and the magnitude of the interests confided to us; yet you, as students in medicine, have scarcely anything to do with this at present. It will be sufficient for you to feel that, as far as *you* are individually concerned, your profession will hereafter enable you to make your social rank, whatever you shall resolve to make your profession to yourselves. For it may be truly alleged, that if a medical man takes a high view of his pursuits, and acts conformably to his standard, it will introduce him to the society of the most gifted minds, will secure to him the esteem and respect of the best and noblest natures, with the affectionate gratitude of all who can appreciate the personal and priceless benefits it enables him to dispense around him. Whereas, on the other hand, if a low notion be conceived of it, if he allow himself habitually to regard it, simply or chiefly, as a means of accumulating wealth, or of increasing his influence and position in the world, if, in a word, he prosecute it in a narrow, unworthy, selfish spirit, while he may fail of attaining even those inferior advantages to which he had limited his view (lawful and even laudable in their degree, as these unquestionably are), he will inevitably fall short of those much more valuable rewards, which a juster and truer estimate of it might have ensured to him.

Of the countless occupations in which mankind are engaged all may be regarded as in themselves honourable, which, while they do no violence to the cultivated moral sense, are intended to supply a legitimate human want, or conduce in any degree to the convenience, the happiness, or the dignity of social life. However humble, or conventionally debased, there is no such pursuit that does not admit of being followed in a spirit which shall sanctify it.

But I desire to speak now rather of the *influences of callings and professions on those who exercise them*; and here it needs scarcely a glance to see how widely they differ, as regards their tendency to draw forth the higher qualities of man, to develop his intellectual and moral faculties, to clear his mind of prejudice and error, to enlarge his views of nature and providence, to awaken kindly sympathies in his breast, and thus to elevate, while they soften and humanize him.

Some there are, which so engross his hours with mechanical or physical toil, as to leave no leisure for mental cultivation, hardly for the every-day duties of domestic or civil life; under circumstances, besides, that too often, it may be feared, abandon the better part of his nature to the grovelling tastes of a degrading sensualism.

Other callings are directed, in various modes, either to the production or distribution of wealth in its thousand shapes; and these are mainly concerned with the *material* interests of the community, and offer little scope for, or at least do not necessarily encourage, the improvement of our higher powers. Among them, indeed, are several that have close and intimate relations to physical science, and lead the mind to grand conceptions of natural laws, and train it to exact reasoning; while, by stimulating the inventive and constructive faculties, they are gradually subjugating to the benefit and use of man the most subtle and the most tremendous forces of nature, and establishing an empire over the material world which our age cannot help contemplating with something of awe, under a feeling that it may be ushering in a new and unexampled phase in the development of our race. The statesman, too, and legislator, and soldier, are called on to consider problems of vast importance to mankind, and to enact great and stirring parts, where there is room for the display of those qualities, which men term *great.* But of all these occupations it may be said, with more or less truth, that they either do not directly interest him who follows them in the subject of human happiness, or they regard mankind in the aggregate, and do not necessarily bring him into close and personal contact, and therefore sympathy, with individuals.

But it is the distinguishing characteristic of the *medical* profession (shared by but one other), and a fertile source of its special privileges as well as of some of its peculiar trials, that it *does* bring us into this intimate and individual contact with our fellow men; that it lays open to us their private circumstances, their personal infirmities and griefs, their hopes and fears; making us acquainted with human nature under aspects and forms which even the ministers of religion have not always the opportunity of witnessing, and which are fraught with the most salutary lessons for those who are willing to learn wisdom from the dear-bought experience of others. It conducts us, I say, into the very presence of the souls of our fellow-creatures, who expose to us their cherished and most secret thoughts, in willing trust that we shall employ the knowledge thus committed to us for the *private* and *individual* object of restoring them to health. We are made the depository of personal and family histories, that we may have the means of interposing the friendly aid of our skill and experience for the removal of disease, or, at least, the relief of suffering and the prolongation of life. These great and pressing interests thus intrusted to our keeping, not in the mass, but with all their vivid details and for so sacred a purpose, must excite in every well constituted mind a warm solicitude for the welfare of our patients, and call forth the best feelings of the heart.

Well and *wisely*, in my opinion, gentlemen, may you congratulate yourselves on having undertaken a profession which will thus enable you to study mankind under peculiar advantages, which must lead you to look kindly on their weaknesses, while it enlists your whole energies in their behalf. *Thankful* may you be that you have embraced a profession wherein you will have constant opportunities of storing up peaceful recollections of benefits conferred on your fellow-creatures, by labour and skill in the path of your daily duties. A life of active usefulness lies before you, in which, if you choose, you may find the obligations of duty in constant accordance with the promptings of your better nature, no less than with the example of Him, who was Himself the great Physician, and who wrought the miracles that were to estalbish His doctrine, not to impart honour or wealth to man, but to heal his stricken body, to restore to him the blessings of health and life.

The real and essential dignity of the healing art must ever primarily consist in the *beneficence of its object.* To remove disease and assuage pain, to reanimate the dying body and recall the wandering mind, must ever be an office truly noble, while the current of human life shall continue to flow in its present frail and easily interrupted channels, while the circumstances of man's condition are such as to expose to a thousand causes of derangement that balance of the complicated movements of life which we term "*health.*" And the sentence of the heathen orator will remain, except in one word, worthy of a Christian age, "*Nihilo magis homines diis appropinquant quam salutem hominibus dando.*"

But in considering the claims of our profession on our respect, we may not rest in a barren contemplation of its object, however worthy and exalted; for we see that object daily put forward to conceal the deformity of counterfeit systems of selfish imposture. We must proceed to test its worth by the inquiry, how far it pursues this noble object by *rational* means, and in what degree those means are not merely rational, but *elevating* and *ennobling*, to those who employ them.

Now on this question we may observe, (1) That the foundations of medicine extend very widely and deeply into *many large* departments of human knowledge; and (2) That our profession draws its knowledge and experience from every quarter which promises a useful return.

A knowledge of the influence and use of the agencies at our command, in treating the disorders of the body, is a subject of such vast relations, as hardly to fall within assignable limits; but there are certain divisions of science in which all available experience in medicine may be said to centre. And first, that of the human frame itself, the seat of the derangements to be rectified, the structure on which we are to operate. We study its form and mechanism, the complex array of its parts, mutually adapted and diversely similar, compacted by a principle of unity, and having definite relations of conformation to the world of organization around us. We examine it in its active breathing state, detect the phenomena of its origin, the stages of its development, growth and decay; we watch its modes of action, and the change it produces in the matter with which it deals, and which is ever traversing its pores and passages, absorbed, assimilated, and rejected under the ceaseless influence of the principle of life. Hence we rise to the comprehension of the general laws by which our all-wise and bountiful Creator governs and sustains all these wonderful actions, and become able to frame a reasonable explanation of many of the maladies to which they are liable, and to deduce rules for the maintenance of health.

Next, we pass to the study of this body in its states of illness and disorder; we note the phenomena that its functions present when diverted from their usual course by the intervention of disturbing causes; and examine the alterations of structure which accompany such deviations from the correct standard. Thus we obtain an insight into the *natural history of disease.*

Lastly, we have to ascertain the powers which have been mercifully placed within our reach for the mitigation of bodily distress, and the removal of disease; to draw from the bowels of the earth, from the bed of the ocean, and from the trackless fields of air, those remedial agents that lie profusely scattered through the realms of nature. We have to turn noxious substances into balm, and poisons into antidotes, under the guidance of a careful and discriminating observation of the effects of surrounding matter on the corporeal frame, both in health, and under the endless varieties of disease.

The three great departments to which I have now thus briefly alluded (the sciences touching the human frame in health, the science of disease, and the science of remedies and their application), may be compared to centres, round which cluster all those special subdivisions of scientific knowledge which yield their tribute to medicine; or, we might resemble them to three great branches of a tree, deriving strength and vigour from many subordinate ramifications. The study of the healing art in these three provinces commends itself to the common sense of mankind as the only rational mode of obtaining a sound, comprehensive, and useful knowledge of it. Strange that there should be found even educated men lending themselves to the delusions of quackery, and ready to reject as superfluous some or all of these necessary though still imperfect sciences, and to adopt the systems of madmen or knaves, under the shallow and transparent pretext of a simplicity, which is simple only by excluding almost all well-grounded experience in medicine!

In pursuing the course thus rapidly sketched out, rational medicine adopts all the true results of observation and seeks to reduce them into order—searching amid the heterogeneous assemblage of reputed facts for those leading guiding lights which serve to dispel the gloom in which mere empirical knowledge is shrouded. Yet it does not reject or overlook what is fairly proved, because it can find no place for it as yet in its system. It is content in its present state of imperfection to mingle the empirical with the scientific, though ever striving to bring empirical facts under the control of law. In reducing the body of experience to rules, it does not make itself the slave of rules or systems, remembering the complexity of the problems before it, the uncertainty and necessary occultness of many of the conditions involved, the multitude of modifying influences. It stores up experience with simplicity of mind, is ever forward to receive new facts, and to pursue fresh avenues of research. With patient industry and singleness of purpose it adopts knowledge from every quarter, and casts aside nothing as worthless that comes to it on reasonable testimony. It is not conceited, but candid and open. It may fall into the errors that are but incident to human thought, and the usual accompaniments of periods of great mental progress, but it is always willing to be guided to the truth, being animated above all things by a love of truth. It is ready to exclaim with Locke, "It is *truth* alone I seek, and *that* will always be welcome to me, when or from whence soever it comes." It knows, indeed, that it is ignorant of the whole truth—that in all, even the most perfect and advanced of human systems of science, there is much to mark the poverty and weakness of our faculties, and therefore it vaunteth not its powers, or its conquests, but is tranquil, patient, humble, modest. If it discovers a new and useful truth, fraught with advantage to mankind, mindful of its great object, and true to that object, it promptly throws it into the common store, "glad to distribute, willing to communicate" it.

This, gentlemen, is the rational and liberal spirit that our profession may generally claim, with honest pride, as worthy of the mission with which it is entrusted; and if at times its annals have been sullied and its tone embittered by the harsh jarrings and acrimonious contentions of personal or party rivalry, in which it may sometimes have appeared that truth was less the object sought than victory over an opponent, charity will justly attribute this to causes by no means peculiar to, or springing out of, the medical calling, but which, indeed, our studies and pursuits have rather a tendency to discourage and repress.

If the faint outline which I have attempted of the nature, objects, and general character of our profession have made any adequate impression on your minds—if it have satisfied your reason and conscience, and raised in you any desire after excellence, you will now be the more ready to grant me your patient attention, while I make a few observations on the incalculable importance to you of the next few years; and on the influence which the view you now take of them will exercise, not only on the successful prosecution of your studies here, but on the whole course of your future lives.

Bear with me then, gentlemen, while I say, that although you are now become *medical* students, and are come to King's College for instruction in the elements of *professional* knowlege, yet you cannot attain this knowledge in its most genuine and useful form—and certainly you cannot apply it hereafter, as it deserves, to its legitimate objects—unless you plant its foundations now in integrity and uprightness, in honesty of purpose, and an earnest Christian spirit—unless in this, the plastic period of youth, when your characters are being moulded, you acquire the mastery over yourselves, and resolve to be governed by pure motives of action.

We are born into the world, let us remember, to glorify our Maker in the exercise of those faculties with which He has endowed us; and not only in the exercise, but also in the cultivation and improvement of them to the utmost possible extent.

Of our *corporeal* powers I need not speak particularly, except to remind you that it is our duty, as well as our interest, to take care of our bodily health. It is a talent entrusted to us, and must neither be squandered nor permitted to rust. Any wilful disregard of the rules of health is in a degree culpable. Our duty and usefulness are interfered with by ill-health, and our bodily powers were not given us to be abused—to be overwrought, or to be subjected to any wasteful excesses or besotting indulgences. Do not therefore forget, in the ardour of study, in the strong yearning for advancement in knowledge, that your corporeal and mental capacities are limited by laws which cannot with impunity be broken, and which appoint to us natural terms of refreshment and rest. These require to be observed, if you would retain your youthful vigour, and accomplish what is before you. Be not impatient, or long for premature proficiency, but pursue with regularity, and within the limits of your physical ability, the work that lies before you, and be assured that you shall sooner and with more certainty thus attain the goal of your wishes, than if you recklessly disregarded the measure of your strength and drew upon it at random at the outset.

In the next place, it is of great importance to your future success in life, no less than to your present advancement in study, that you should carefully attend to the exercise and training of the *mental* powers. To do this will be to " whet the edge " for the intellectual conflict, and will be in the place of " putting to more strength." " Wisdom is profitable to direct." Any exertions you make with this object will be laid out at the most abundant interest, and will be followed by a return not only immediate and great, but ever multiplying itself for the rest of your life.

You are now at an age possessing the greatest advantages for the work you are to accomplish, and it is right you should recognise what these are, in order that you may set store by them, and apply them to their proper use.

And first, you have *leisure*, which will never return. You have now *time* to lay a secure and lasting foundation ; by-and-bye you will be called on to raise the superstructure. There is a season for the ear to swell and the seed to ripen, as well as for the harvest and the in-gathering, and the one cannot take the place of the other, nor if one fail can the other prosper. Shortly will commence the active duties of life, and to learn what you have now to learn will then be too late. Then will come the cares and responsibilities of practice, with new relations and distracting engagements. These will certainly occupy the greatest portion of your time, and interfere much with study. When each day shall bring with it its own labours, and imperatively exact their performance, you will find it impossible to recover opportunities which you may now have let slip ; for with the time and knowledge lost or foregone will have been also lost much of the power of sustained application, of intense and regular industry ; and you will be dispirited by a sense of what you might have been, had your pupilage been otherwise spent. Then will you begin to *realise* what depth of meaning lies under those brief and oft-neglected phrases—the shortness of life, the value of time ; and to realise it when too late for profitable use will bring a sense of abiding regret, if not still worse, a callous and death-like indifference.

Now, too, you enjoy energy and elasticity of spirit ; you have hope and trust in the future ; you have freedom of mind and disinterestedness. All these will help you to labour aright. They are precious gifts, graciously committed to you, to be employed as the Giver has vouchsafed to appoint, and of which hereafter an account must be rendered. They leave you without excuse, if you neglect to avail yourselves of the aids they supply.

To pursue with success a scheme or system of mental training, you must believe that the result is within your reach ; and to be satisfied of this, it will perhaps be sufficient for me to refer each one of you to the experience he must have acquired, by the observation of himself or others. By well-directed exercise and discipline the limbs and bodily organs may be trained to such a pitch of strength and agility, as to astonish and delight us in the feats of the circus, and to seem to endow their possessor with new corporeal powers. But this conveys but a faint idea of the capacity for improvement of our mental faculties, under skilful guidance and a determined will.

There are, indeed, original differences between men, in both the extent and fertility of the intellectual soil; and the seeds sown find in some a more genial welcome, and spring up in ampler luxuriance and display greater richness and abundance of flower and fruit than in others. Though in all perchance the ground be substantially good, and the kindly influences of air and sunshine, season and climate the same, yet some will yield thirty, some sixty, and some an hundred. But with these varieties of the innate endowments we are little concerned, except to guard against being deceived by them into the belief that it is these chiefly which govern the positions which men take in life; for it is far otherwise. The wisest and most experienced of men will tell you, that it is the formation of habits of steady and regular industry, of conceiving ideas clearly, and storing them methodically, so as to have them always at command when they are wanted—that it is the tutoring the memory to exactness and promptitude, and the judgment to strength and depth—they will say to you that it is mental discipline, perseveringly pursued, and turned to right ends, under the sustaining and directing influence of worthy motives, which really decides the differences between man and man, whether in regard to mental constitution and powers, or the effect these produce on life and conduct.

If any one of you, therefore, should imagine, in the silence of his own breast, that he has powers of a superior order, let him bless Him who has given them, but beware lest they prove a snare to him—a curse and not a blessing—by leading him to forget that, without care, they will degenerate and leave him far behind others, whom he may now, perhaps, fancy his inferiors in ability, and altogether deficient in genius. Let him remember the awful words, "Of him to whom much is given, shall much be required," and resolve to employ those means of excellent usefulness, with which, without any merit of his own, he has been born, in such a manner as to win the far greater blessing of an approving conscience.

On the other hand, let those be strongly encouraged who are conscious that their memory is feeble, their attention apt to wander, their conceptions too often wanting in clearness and precision, by the recollection of what others, similarly circumstanced, have accomplished by the means which have been hinted at; and let them believe earnestly in their own equal capacity of improvement. It is well they should be convinced that in the long run, though with powers not above mediocrity, and with even fewer of the external advantages, perhaps, of wealth, of friends, or of position, they may, by persevering industry and the careful education of their powers, outstrip those who relied on their uncultivated genius, and in whom they may now be almost disposed to envy this flattering possession. But I slide into expressions which might seem to imply that precedence in the race of life is the test of merit and of real success. A desire to obtain it is *not* to be made your *leading* motive. It may fail from causes not under your own control; it may fail and leave you yet happy, or it may come and find you miserable. Therefore this should rather be your determination, "Let me resolve, with God's blessing, to *do my duty* and to improve my faculties to the uttermost, and leave the issue in His hands, certain that I shall then be safe under any worldly fortune."

Among the aids to mental culture that may lie within your reach, there are none more influential than those with which the Collegiate system will here surround you; and undoubtedly it is expedient for you rightly to appreciate them, both in order that you may conduct yourselves as you ought towards that community with which you are here connected, and also that your own characters may derive the full benefits which the influences of the place are so well calculated to impart.

It is with feelings of thankfulness that the professors must acknowledge the kindly and confiding spirit with which the students have habitually concurred in all the arrangements established amongst us, and we have only to express our expectation and hope that this cordial acquiescence will continue on the part of those now joining us. They will feel persuaded, we trust, that the order and regularity of our College life, a willing obedience to all the rules, a diligent attendance at the lectures prescribed by the authorities of our profession are powerful means by which they may cultivate in themselves habits of self-control, and especially of order, method, and punctuality: habits most essential to usefulness, particularly in a profession like ours. For the unavoidable distractions to which the practitioner in medicine is exposed, require in him all the more heed to economy in the disposal of his time; and a loose, unpunctual habit, while it deprives him of the little leisure which he might otherwise enjoy, causes him also to be wasteful of the time of others. Moreover, the public will naturally estimate him by such qualities as they can readily apprehend, rather than by his medical attainments, of which they feel themselves to be imperfect judges, and so grave and glaring a defect of character is almost certain to interfere seriously with his success.

I now proceed to offer a few remarks, such as the briefness of the time permits, on the studies that are about to engage your attention.

These studies relate to medicine as a *science* and as an *art*, for in this twofold aspect you must learn to look on your profession. The sciences which lie at its foundation are to be studied partly as sciences, partly in their practical applications to the art. Without a scientific knowledge of the principles and laws which preside over the natural operations of the living body, you cannot be said to understand, even vaguely, the nature of the derangements of disease; and without a scientific insight into morbid conditions, it will be impossible to adapt your treatment skilfully to the varieties which they manifest, or to be other than the slaves of empirical rules, blindly applying the same remedies under circumstances wholly different, and constantly at a loss when new phenomena unexpectedly present themselves.

But on the other hand, it would be the greatest mistake to suppose that a profound acquaintance with such sciences as Chemistry, Botany, Anatomy, Physiology, or even Pathology, and of these even in their practical aspects, can be sufficient to constitute you able physicians and surgeons. Nothing can possibly do this but the adding to your science a close and extensive personal familiarity with the phenomena of disease, and with the actual changes produced by medical interference. And nothing can give you this practical familiarity but a long and patient study of details, which do not much admit of scientific arrangement, but must be collected promiscuously, and by every student for himself, by persevering and laborious observation of the art, as it is carried out in the practice of its experienced professors. It is this that gives value to the opinion of the older members of our profession, compared with the younger, in obscure and difficult cases. Much of their knowledge is incommunicable, and as they have accumulated it for themselves, so must it perish with them. This is the fate of our art, more than of most others. Perhaps it leads to greater strides of progress from one generation to another, by preventing a too close or implicit imitation of one age by another and by encouraging independent thought.

In studying Physiology, you will endeavour to understand the intimate nature of the phenomena of health, the inter-dependence of the several organs and functions, the relation of the parts to the whole ; so that in the application of your knowledge to the explanation of diseased states, you may never lose sight of the general and leading principles, which demand attention in all instances, and can never be overlooked with safety. Your minds should be so imbued with physiological principles, that when disease is presented to you, you may at once regard it in its relation to the standard of health, and not as some separate entity, to be combated and overcome without reference to the natural powers and requirements of the bodily organs.

So grounded in a knowledge of the healthy state, and accustomed to address all your remedies and means to its restoration, you will be induced and prepared to cultivate, on all occasions, a *habit of thinking*—of meditating on, and of striving to understand, the morbid aberrations that you are called upon to rectify. You will gain, by degrees, a kind and extent of insight—of *scientific insight*—into the cases you have to treat, which will make you intelligent and sagacious practitioners, while it will prove a constant source of intellectual delight, and attach you to the laborious pursuits of our profession, and diffuse over even its more disagreeable provinces an ever-growing interest and charm.

And here I cannot avoid saying a few words on the peculiar advantages which medicine derives from its close connection with several departments of natural science. I am far from meaning that it will be your business at present to strive to make yourselves profound chemists, or botanists, or physiologists. To do so would almost necessarily lead to your neglecting some of the practical subjects, which are truly the occasion for which you study these foundation-sciences ; and if you gave yourselves too exclusively, or too fondly, to these, you might lose your relish for practice, and thus divorce your minds from the legitimate object of their concern, the *application of all suitable knowledge to the relief of human suffering.*

But I do assert that the study of these sciences, as sciences, so far as time may allow, and of each in its proper degree, proportionate to its importance to medicine and surgery, will be an admirable instrument of mental discipline, training the mind to accurate reasoning, enabling you to detect plausible fallacies, and exercising the memory, besides giving you a comprehensive grasp of your subject and a discriminating judgment, which will prove of most essential value in determining the complex and doubtful problems of disease.

And if you should be fortunate enough when young to imbibe a taste for any of these sciences—a taste unselfish, pure, and elevating, a taste entirely in harmony with the character of your future pursuits, and which, if properly restrained, can never be correctly regarded by the public as inconsistent with your professional duties, but, on the contrary, as rather giving to your services a nobler stamp—you will be blessed with an inward source of peaceful happiness, of which no possible amount of professional occupation, and no accident of worldly position, can deprive you.

With reference to the subjects of the several courses of lectures which you are to attend in their order, my colleagues will no doubt explain and enforce their respective value, and it will therefore be unnecessary for me to touch upon them. But there are two parts of your studies which are to occupy a very large share of the whole time you are to spend here, and of which I cannot too earnestly press upon you the importance. I mean the *dissecting-room* and the *hospital.*

An almost constant familiarity with both of these for nearly twenty years, has only added weight to the conviction I early imbibed, that a student's time should be very largely given to these two pursuits.

The surgeon ought to be as familar with human anatomy as with the structure and furniture of his home. He should be able to recognise and find any part or object, as it were, in the dark and without a puzzle of the memory. One who has this exact and ready knowledge possesses an immense advantage, for he will feel master of numberless details relating to his profession—he will not be at a loss on emergencies, or novel turns, or accidents, but will maintain a calm and collected mind during the most perplexing and critical operations. This knowledge can be attained *only* by careful and repeated dissections, for which the best lectures, and written or pictorial descriptions can furnish no substitute, however valuable and necessary as aids. *Ex libris nemo evasit artifex.* Be assured that in the hour when health and life shall be committed to your charge, and you become awakened to a full sense of your responsibility; when you are called upon to decide on an operation, or to perform it, on parts where a false step may rob your patient of some of his few chances of life, or may hurry him into eternity—you will then experience the difference between a knowledge of anatomy acquired by practice in the dissecting-rooms, and that faint trace which the memory may retain of ideas, not originally impressed by the fresh and vivid touch of nature.

The dissecting-rooms are a scene of study to which no other profession affords a parallel. While they retain their novelty, you cannot enter them without a certain reverential awe, inspired by the thought that you are walking among the dead. An earnest and right-minded man will not too forcibly repress this feeling, nor forget, in that customary place, the honour due to human dust, nor so dismiss his own mortality from his recollection, as to behave with any unbecoming or ill-timed levity. He will strictly apply himself when there to the acquisition of the necessary knowledge, reminding himself sometimes that the dead body on which he operates has once been tenanted by the soul of man; that in all probability the Divine Spirit has once deigned His presence there; and, finally, that its scattered elements are destined to be one day reconstructed, and, in a changed and purified state of incorruption, to resume their mysterious but essential part in the life of an immortal being.

If a practical knowledge of anatomy is so desirable for the student—how important, how indispensably necessary must be that practical knowledge of disease, and its treatment, which the wards of an hospital supply! There he is brought face to face with almost all that distinguishes his profession. He sees it as practised by those from whom he is acquiring the rudiments which are to fit him for it. He sees applied the doctrines inculcated in the systematic courses, and thus learns to appreciate them more highly. He is led, on the one hand, to feel the interest which practical applications reflect on his elementary studies; and on the other to infuse into his views of practice a rational and scientific spirit, which will probably give a colouring to them for the rest of his life. He drinks at the fountain-head of knowledge, he reads the book of nature, and observes for himself those processes of decay, those forms of active and chronic disease, from which his teachers have drawn the information they are imparting to him. Disease is no longer an abstract thing—portrayed, perhaps, by the hand of a living master, yet still a portrait only—but he has now before his eyes the pallid countenance, he listens to the sounds, he feels the throbbings, he watches and records those hundred changes which are to be his own guides hereafter in daily passages of peril and anxiety. He sees it as it affects living men, he is a witness of their sufferings, their patience, their hopes, and fears, and imperceptibly finds his feelings enlisted on the side of his studies. He begins to understand how age, and sex, and previous habits, and the fluctuations of worldly circumstances, whether physical or moral, exercise a powerful influence over the course of diseases, and demand modifications in their treatment. He is thus taught lessons of watchfulness, caution, and decision; and, by degress, experiences something of that confidence which a sense of real knowledge confers, and becomes prepared for observing, for thinking, and acting for himself hereafter.

Gentlemen, I am exceedingly anxious to impress upon you all, the extreme importance of your devoting all the time you can spare from college duties to study in the wards and in the out-patient rooms; and it is most gratifying to be able to announce that, ere long our accommodations for this all-essential department will be more ample than they are at present. The first stone of the new building will be laid early in the spring, and no time will be lost in hastening the work to its completion. Meanwhile, take full advantage of the means which the existing hospital affords. If not engaged in dissection visit it daily, and when there, employ your time diligently in watching the progress of the cases, and in note-taking, as well as in a regular attendance at the clinical lectures and at the *post mortem* examinations of the bodies of those who die. Read also, on the cases which you are observing and recording. As you watch them from day to day, and write out your notes in the evening, refer as much as possible on the subject of them to the works of the great standard authors of our profession, authors too little read by the student and young practitioner of the present day. See how the diseases you are engaged upon have been regarded by men of the greatest genius and the largest experience. Do not dare to despise them because, forsooth, their phraseology may be in some respects antiquated, or because on some subjects they betray false views which belong not to them but to their age. Trace the current of their thoughts, their sagacious discriminating judgment, and admire their descriptions of disease, so terse, yet so graphic and true, that it is impossible not to have your own case elucidated by them, and your ideas simplified. Thus you will cherish a habit of reflection on the phenomena of disease; you will learn to observe more acutely, to reason more sagaciously and to draw more correctly your conclusions. You cannot over-estimate the value of such a habit in after life.

Those of you who are now commencing your professional education will of course at first find much that is novel and strange in hospital practice, and you will very imperfectly comprehend much of what you see. This must be so; but do not, therefore, be deterred from hospital observation; on the contrary, like travellers in a strange country, be rather stimulated by the novelty of all before you, to take such notes as you can; inquire of your senior fellow students, ask questions of the professors, refer to your books, and gradually all will become clear. Only do not let the hospital detain you from any of the elementary lectures of the first session (and I refer especially to chemistry, the hour for which follows the hospital hour), for these may not be neglected. If, when not occupied with dissection, you give up the mid-day hour to the hospital, and employ this hour strictly as I have recommended, you will be surprised, I venture to say, at the progress which even six winter months will have accomplished, and in the summer you will have still more leisure for the hospital, and less of lecture engagements.

Gentlemen, if there is one thing more than another in the circumstances of my own education, which I am now inclined to look back upon with especial thankfulness, it is, that for several years a large hospital was my home; and I do most earnestly press it upon you, as you value your future success, study disease as you have time, from first to last, through the whole of the next three or four years, at the bedside. Preserve notes of cases; illustrate them if you are able, by sketches or drawings. You will observe them much more narrowly, much more methodically, if you write notes; and, therefore, you will remember them better; besides that you will have the advantage of a book of reference, a body of practice accumulated by yourselves, and rescued from the oblivion which ever tends to swallow up the past, a guarantee that you have well and carefully employed the opportunities, which to most of you can never return.

On the subject of the hospital, I have only further to remind you, that it can serve you in its subordinate capacity as a school of medicine and surgery only in proportion as it fulfils, at the same time, its primary and more essential function of a great instrument of charity, ministering the aids of benevolence and medical skill to the teeming thousands of our poorer brethren, in their seasons of affliction. You are permitted to cluster round the couch of sickness and bodily anguish, and to hear the accents of penitence or despair, not because you are now able to do much, if anything, to alleviate its pangs, but in order that you may learn how to contend most effectually hereafter, by a silent and invisible energy, with the powers of destruction, and thus to mitigate or remove the future sufferings of others. It is this sacred object *alone* which allows you to intrude your prying footsteps into the stillness of the chambers of the sick, to watch the pauses and returns of illness, and to gaze even on the countenance that " death, under the ravages of disease, has marked for his victim, and covered with his shade."

I am persuaded that a sense of the presence in which you stand at the hospital, will maintain in you that strict propriety of conduct, on all occasions, and that tranquil and noiseless demeanour, which are befitting the place, no less than the business on which you are engaged. I am sure that the occasions of intercourse with the poorer classes will be improved by you as they deserve; and that nothing will occur, in the bearing or behaviour of any of you, within the walls of the hospital, to give pain or disquietude to the minds of those excellent and benevolent persons, who, with so much self-devotion and ability, conduct its management and promote its success.

Under many discouragements and difficulties, I know they are sustained by the desire of sharing, in their appropriate sphere, in the great and noble object of educating for the ranks of a profession which they honour, a number, not only of scientific and well-instructed *practitioners*, but of *Christian gentlemen.* And you must feel that few things could dishearten them more, or be more likely to make them relinquish their disinterested labours on our behalf, than to find the wards or precincts of the hospital desecrated (for I can use no milder term) by any conduct which could disgrace it. The honour and credit of the College, besides, are most closely bound up with the character of the Hospital, for it is there that the world naturally looks for a first exemplification of the influence for good, which the principles of the College should be exercising on the students.

There yet remains one topic, on which I have a very few observations to make; and I offer them in particular, as so much of this address has been offered, to the junior students. It is a subject on which their eventual prosperity depends, much more than might at first sight appear—I mean the employment of what is usually styled *leisure time*, *vacant hours*. So highly is this to be rated that it may almost be made the test by which the future career of a young man may be measured. There are necessary intervals in the occupation of the busiest of mankind; there are many, and sometimes long intervals in the day of every medical student, which no pre-arranged scheme of study can fill up, and which expose him to that great trial—the having a plausible excuse to himself and others for idleness. If he do not foresee that such intervals will occur, and provide himself beforehand with some useful and ready employment for them, he will not only dissipate much time in the aggregate, but slide into listless, careless habits of mind, in which he will be obnoxious to the encroachments of many insidious forms of folly, if not of vice. An active preoccupation of the mind on some worthy and useful pursuit is the most effectual safeguard against these. The medical library is provided as a place of quiet study during the college hours, and there can hardly be a better subject for the occupation of brief periods of leisure than the reviewing, by the aid of notes and class-books, the ground over which he is being taken by the professors, or by his own observations in the hospital. The museums, too, are a rich storehouse, from which much and varied knowledge may be easily acquired by the student's unassisted efforts at broken moments of time. And I am far from implying that he should not relax his mind in innocent or improving conversation, or in congenial society, or in any proper recreation.

But when all this has been done, some periods of *leisure* will remain to him when medical studies are either concluded or have wearied the mind, and it will then be wise in him to refresh his powers, not by idleness, but by varying the subject of study. Let him turn to books, the solace and delight of the most excellent men in all ages, and a means by which he may adorn his mind and store it with just and pleasing ideas, and render himself more fitted to associate, on terms of equality, with the scholar and the man of taste in any community in which his lot may be cast. And as the hours which he has to devote to the general cultivation of the mind in this way are, after all, comparatively *few*, let him be true to himself, and turn them to the best account, by a judicious selection. Books are so numerous now, and of all kinds—good, bad and indifferent (the last infinitely the most numerous), that it may seem no easy matter to make a choice; and of course it must be sufficient to proceed on some general principle, and to allow oneself the liberty of many exceptions. But I cannot help thinking that you will be unwise if you omit to choose among others, as companions of your leisure, the works of the *standard authors* of the world, whether of antiquity or of a later age, whether those relating to history, or philosophy, or poetry. It is surely better to select the higher models, the creations of genius, guaranteed as sterling ore by the stamp of universal opinion, even if you also gratify a harmless taste in the perusal of the lighter productions of the day or of the hour.

But if it be true, that we should be almost as careful of the books we habitually read as of the personal intimacies we form, especially where their tone and character are such as to be likely to sway our moral being, then we cannot be too much on our guard as to the *bad*, or the *partially bad* books which offer themselves (sometimes under enticing and pleasant forms enough) for our perusal. Sure I am, that one cannot willingly peruse an impure or immoral work without being debased by it. It is touching pitch. One cannot be often reading frivolous novels without having our intellectual faculties weakened, and our taste corrupted; nor without at the same time becoming indisposed for more wholesome and excellent fare.

In conclusion, gentlemen, think nobly of your profession, and by your own conduct make it worthy in your own persons of the standard at which you estimate it. Remember that its end is beneficent, its studies ennobling and elevating, its administrations an exercise of our best faculties, and in harmony with the whole constitution of our nature. To excel in it is an aim worthy of all your aspirations, of all your energies; but requiring mental and moral discipline, patient and sustained labour. Go forward in this path with diligence. Make of your difficulties a school in which strength of character may be tried and formed, and convert them from adversaries into your best friends. There is no sweeter recollection than the sense of difficulties overcome. Strive rather to shine in yourselves than to outshine others. Seek less to derive honour from your profession, than to honour your profession by your virtues. Cultivate a love of knowledge for the sake of the benefits it will enable you to dispense, as well as for the gratification of your own higher tastes and capacities; and then, whatever worldly fortune betide, you will win the most valuable of the blessings which the occupation of a life can confer, the satisfaction in the retrospect, of having improved your opportunities, of having acted on right principles, of having been the honoured means of benefiting your fellow creatures, while humbly yet earnestly endeavouring under the Divine blessing, to accomplish the will of your Maker, and to live to His glory.

VIII.

ADDRESS IN SURGERY

Read at Chester, August 9, 1866, *at the Twenty-fourth Annual Meeting of the British Medical Association, by* William Bowman, *Hon. M.D. Dublin, Hon. LL.D. Cantab, F.R.S.* [*From a Reprint by "The Association for the Advancement of Medicine by Research,"* 1882.]

Mr. President and Gentlemen,—Surgery has always been that department of the Healing Art which most strikes the imagination of mankind, and secures their admiration, by prompt, dexterous interposition, in obvious and great perils, where life or limb is jeopardized, when the ignorant or timid are ready to despair, or the disease seems too terrible and deadly to be controlled. One now steps in, holding in his hand the talismanic charm of knowledge, with skill to find and courage to touch, for their correction, the hidden springs of life, and in a few moments how altered is the scene! The poor sufferer, a weeping family, or, it may be, a nation in deep anxiety, is relieved; and gratitude, the most precious human tribute for so great a benefit, so opportunely conferred, mingles with the respect and almost veneration that greet the successful operator.

Pardon me, if I avow, arrived at middle age, that my boyish ambition—not far from this *Cestria* of the old Romans, and under the inspiration partly of one still among us (my father's friend),* partly of others to whom I am even more deeply beholden—was to be a great surgeon. And though I am able thankfully to acknowledge a gradual diversion of my lot in life away from this dream of earlier days, I yield to none in my regard for the eminent dignity of the Surgical Art, concerned, as it is, with some of the dearest earthly interests of mankind, and certain to rise more and more in their esteem as they become more capable of weighing things and men by the true and real standard of *their usefulness.* For I see no reason to doubt that future ages will still accept the pious saying of one of old, that Surgery is the *Hands of God:* the Human Hands, apt images and reflex of Man's whole Being, from his morning hour of puling helplessness, when the

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* Thomas Taylor Griffith, Esq., F.R.C.S., of Wrexham, ob. 1876, æt. 80. At the age of twenty—viz., in 1816—he had obtained Sir Astley Cooper's first prize in Anatomy and Surgery at Guy's. He was the leading practitioner of his time in his own county, following a father equally eminent.

> . . . . tender palm is prest
> Against the circle of the breast;*

through all his working day of time, until they shall be upraised once more at last in joy and adoration, to hail a brighter and an eternal dawning; the Human Hands, permitted now, through insight into God's laws, to be His instruments of succour to that earthly life and organization, which His power, wisdom, and love, having first brought into being, still alone both sustain and cause to perish when their part is played; to that material organization which dies every hour it lives, which indeed dies by living and lives by dying, and which wondrously transmits ever its own prerogatives and dark secrets to a succeeding life, destined apparently to remain a marvel and a mystery impenetrable to all generations.

A general survey of the present state of the Healing Art in those countries that most represent the recent progress of mankind, may well incline us, on an occasion such as this, to outstep the narrow limits of the Speciality of Surgery, to which, indeed, our precedents do not confine us, and to inquire whether we be not in some danger in England now, amid the multitudinous divergencies and details of modern practice, of losing sight, in some measure, of the essential Unity that pervades our whole work of Healing in the World; and further, whether we do not need to hold more to this central idea of unity, in order by greater concentration of our powers and agencies for good, more effectually to promote the proper objects of our great profession, by better directed common efforts than in times past.

And can such a theme be more appropriately handled, than before an Association which is, up to the present moment, the only visible upholder and representative of the comprehensive unity of all ranks and degrees of Healers in this country, and which has been for many years working towards the realization of it?

Let us, then, spend a short time in tracing, if we can, the scope and meaning of this work of ours, which interests ourselves so very closely, and our fellow-men hardly less. And for this purpose our past history shall first be adverted to, so that we may gain, as from a distance, a more general and a juster view of our whole position.

With the earlier developments of the Art in remote ages we are little concerned, except to observe, that the same simplicity of conception which we now find among our less instructed countrymen, implied in their respectful customary epithet of "Doctor" addressed to us all alike, regardless happily both of University-acquired titles of too motley import and of modern Acts of Parliament—this same simplicity of conception would probably apply still more to the Healers of a dawning civilization;

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* 'In Memoriam,' xliv.

who, though they then, as now, must have failed in any instance to embrace all knowledge and all the powers of treatment, yet could hardly have been other at first than general practitioners.

Probably the state of the Healing Art (if so it can be called) in various savage tribes, and among the antique and decrepit communities of the East, only now being awakened out of the torpor of tens, perhaps of hundreds of centuries, by the rude shock of contact with modern European forces, may exhibit to us, not inaptly, what it once was among ourselves. Certainly the early growth and moulds of our profession must have been natural, not fostered by artificial means; except indeed where the policy of chiefs, or the craft of a pagan priesthood, may have warped them to their purposes. But generally, where individuals evinced or professed an aptitude, opportunities of experience would be rife enough; and according to the nature and variety of these, would be the developments of knowledge and the divisions of practice.

At a later period, the elaborate civilization of the Greeks and Romans, and subsequently of the Arabians, was manifested scarcely less in their knowledge of Healing than of other useful arts, as their extant writings attest; it being reserved, however, undeniably for Christianity to elicit first among mankind the true spirit, as well as the right exercise of the Art, in the institution of hospitals and asylums, and of nursing brotherhoods and sisterhoods, for the sick and maimed.

But, indeed, although the practice of Surgery in particular must have reflected, like other arts, the prevalent temper and ideas of those times, and may have been often rude, coarse, and undiscriminating, based on loose surmises, false analogies, or on prejudices or fancies altogether absurd, hence becoming what we might now be inclined to call unfeeling, even cruel; yet always, its aim being beneficent, its tendencies must have been so too; a humanizing art, intervening on the side of mercy and pity, even in the wildest hours of savagery or war.

Turning to Britain and the Dark Ages, haply our Chirurgeons were a sorry set, who carried out lamely the despised manual part of treatment, under the direction of an order of men, by priestly office, or by education and social rank, above themselves; to whose authority they bowed: an order of men misnamed learned, ready in every difficulty to quote Galen without understanding him, and generally more ignorant than the poor handicraftsmen they controlled; but men whose word could seldom be questioned, never gainsaid; though, from the falseness of their principles, they could never advance one step in true knowledge.

It was probably war, ever recurring war, that raised a few individuals from time to time into greater prominence and credit as surgeons; for the powerful leaders of armies must have often experienced the benefits of surgical treatment; and in extremities of danger the surgeon must needs have taken a position in the esteem of multitudes, which those would miss who could not or would not staunch a wound, or save a life by operation. And it is inconceivable that, even in those half-barbarous times, the greater sort of minds among the body-Chirurgeons of emperors and kings should not have emancipated themselves from the obviously absurd relationship implied in their being merely the manual executors of the dictates of other men, whose fantastic pedantry, and real ignorance of the practical part, they must necessarily have contemned.

And in civil life a counterpart was seen. Isolated students in convents, cullers of simples, ignorant travelling quacks and mountebanks, bone-setters and leeches, flitting formless creatures in the twilight time. Then came the guild of Herbalists and Barber-Surgeons. Then, from our universities, especially on the revival of learning, Physicians, with a truer scholarship and more open minds, to whom all mankind must ever acknowledge themselves indebted; men competent to hold their place, even in that age of erudition, with the most exalted dignitaries in Church and State, and still maintaining, probably on that very account, their old superiority in station over their less learned chirurgical brethren.

But now, here and there, a real Surgeon rose; bold, clear-sighted, prudent also; successful in grand ventures; startling the popular imagination by some marvellous cures of deep painful disorders, or of portentous aspect, till then deemed incurable. Thus, Operative Surgery in great cities became the surgery of the greatest practitioners, and oftentimes overtopped and overshadowed the reputation of learned *medici;* causing, no doubt, jealousies, which we know to have been keen, but which we may now all the more afford to smile at, as we are certain none such exist amongst ourselves. Surgery thus became studied more and more by a class, as its prizes were great, and some men seemed by tastes and natural gifts more fitted to shine in it. It became an elaborated art, founded on observation of anatomical relations, both healthy and morbid; it began to have a distinct literature, and a body of rules and precepts, which were the subject of public debate and were traditionally transmitted. Its professors increased in numbers and breadth of aim; they even shared with the most skilful physicians in cultivating the knowledges (hardly sciences as yet) which pertain to the Healing Art; and to draw nearer to our own day, they have, within the last hundred years, in this as well as in all civilized countries, borne an equal, in some instances a transcendent, share in enriching and extending the whole field of medicine.

But I am not here, gentlemen, to say flattering things of one department of our art to the disparagement of another. Nothing could be more remote from my intention. On the contrary, I desire to speak the truth only; to show our common aims and victories, and to vindicate the common bond that unites us all. And for this, I must still ask you to revert with me for a moment to Tudor times.

We are tolerably well acquainted with a state of practice in our own metropolis in that day, when some of the most eminent revivers of learning, of whom England is rightly proud (though some of them were favourites of a Court, paid by Church sinecures), established an Institution, since become venerable, which in those days fought a hard and, it must be added, a successful battle with the surgeons before the LORD MAYOR of London and other of the Queen's Delegates (the more enlightened Master of the Rolls and the Bishop of the Diocese bringing, we are told, many opposing arguments on the surgeons' part) for the right and privilege of alone prescribing in surgical cases inward medicines—and such medicines!—when the apothecaries' shops, no less than the chirurgeons' instruments, were still to a large extent under their control; and when, for example, one unhappy JOHN LUKE, *ocularis medicus*, receiving a faculty to treat diseases of the eye, was strictly limited to the use of external means, and forbidden all internal remedies, by whatever avenue they might be introduced, either in the city of London, or in the suburbs, or within a circuit of seven miles, except under the advice of some learned and experienced physician accredited by the College.

All these grave and learned men played their part well, however, according to their light. They upheld among the highest and most cultivated of the land, as we gladly acknowledge their successors do at this day, the dignity of the profession and pursuit of healing. And if they did not plant this dignity in its true seat, knowledge of the frame that is most noble on this earth, and knowledge for the sake of usefulness to suffering man; if they sometimes stifled thought, as when they caused one of their number to recant, who had had the temerity to maintain that Galen was capable of error; we may remember what they did to introduce Anatomy into England, and to advance Surgery itself. Receiving from Lord LUMLEY an endowment under the Great Seal for a Surgery Lecture in the College, they "most thankfully accepted so honourable and generous a donation, and built rooms more ample and spacious for the better celebration of this most Solemn Lecture." And from among them sprang one, whose well-known services to our common calling and to mankind can never be adequately honoured, particularly for the prescient, penetrating, comprehensive character of his intellect, and the clearness of his perceptions; whose name will descend to the latest posterity among the greatest of English worthies.

WILLIAM HARVEY was Professor of Anatomy and of *Chirurgery* to the College of *Physicians*. His character was every way grand. The main feature of it was a supreme love of truth, and an intense longing to penetrate the secrets of organic nature; and for this he asserts always the right and the duty of going straight to the fountain-head of Nature herself, acknowledging no master in things natural, but facts and the evidence of the senses. Modest, gentle, unselfish, courteous, not covetous of honours, he was fearless in asserting new truths, believing in their own native power to live and fructify; slow to controvert errors, knowing that they would disperse of themselves, and that narrow and prejudiced minds would cease to cavil, when the clearer light should have time to blaze forth. Withal he had that deep reverence for the Author of Nature which springs unbidden in the heart from the contemplation of man's own littleness amid works so mighty and so minute. How profound a truth he beautifully proclaims, when he says:—"If you will enter with HERACLITUS in ARISTOTLE into a Workhouse (for so I will call it) for inspection of viler creatures, come hither, for the immortal gods are here likewise, and the Great and Almighty Father is sometimes most conspicuous in the least and most inconsiderable of His Creatures!"

The torch of HARVEY was lighted in Italy, where, while the fine arts were already waning rapidly, Science was rearing erect her standard; and at Padua where he listened to the teaching of the greatest masters of anatomy, medicine, and surgery, FABRICIUS ab AQUAPENDENTE, MINADOUS and CASSERIUS, he must doubtless have discoursed with, and caught the spirit of, one still greater, GALILEO. At home he may probably have known personally, certainly by his works, the immortal author of the 'Advancement of Learning.' Thus is Science exhibited as not of a country, but of the world.

But tracing onwards the progress of the Healing Art in England, we shall find the Institutions, founded at first on traditions and customs which represented the convenience of an imperfect and transitional stage of society, not less than individual tastes, growing rigid under the influence of forms and titles, and gathering around themselves clustering personal and corporate interests, not always in harmony with those higher objects by which alone their establishment could have been at first justified; and thus tending to keep apart, though with decreasing force, the two great bands of a common profession.

The Physicians, it must, I think, be said on the whole, though with some remarkable exceptions, receded during the last century from the spirit and the traditions of HARVEY, while they maintained orations to his memory. It is not surprising that Anatomy and Surgery should have ceased to be actively promoted by a College, which was gradually losing its hold on the surgical domain of practice, in proportion as the surgeons were becoming independent of the old restraint.

The Physicians were now, by their continued abstinence from all manipulative treatment, in a position of increasing isolation as regards a great domain of the field of experience; they were specialists by a great defect, by a self-imposed negation; and the consequence was that many of the higher intellects among them betook themselves to a too exclusive clinical observation of certain classes of disease, analogous to that of some of the ancients, and not sufficiently seconded by deep and personal study of the organic structure, and the laws of life; while others distinguished themselves by learned or philosophical labours, more or less important, and more or less connected with the immediate work of their calling.

The result has been, that the medical world has seen several systems or schemes of treatment promulgated on insufficient bases, but with much pretension to a simplicity, for which Nature supplies no warrant; and which have yielded one after another at the first summons of reason and common sense; not without grave discrediting of the whole profession in the public eye; and not without giving a sort of countenance to that easiness of belief with which, within our own century, have been received by the public the flimsy follies of the shallowest and barrennest, the most credulous and the most boastful of medical phantom-sects, that of the self-styled *homœopaths.* In the more recent times, however, of JOHN RICHARD FARRE, of MATTHEW BAILLIE, and of RICHARD BRIGHT, the physicians have laboured afresh in the patient study of disease; and not only during life, but have themselves, with their own hands and scalpels, sought real knowledge by the personal examination of the organs after death. They have also taken a large and important share in advancing the physical, chemical, and physiological sciences; in these and other ways setting a splendid example, and redeeming a position which might otherwise have been jeopardized.

For the Surgeons had approved themselves the truer followers of HARVEY. Holding always to Anatomy, as by the very nature of their function they found themselves more and more constrained to do, and also finding apter materials for study in the more exposed, and less recondite diseases falling to their care, as well as in the open results of wounds, including those of their own making, they have joined Anatomy, Pathology, and Surgery in a natural alliance, most favourable to progress, and always abounding in new fruits; and have gradually risen in influence; establishing in our great hospitals, and in our fleets and armies an equality of rank with their more erudite, but (must we say it in all kindness ?) unhandy brethren; and unostentatiously but surely asserting more and more the claim of the Surgeon's Hand to be guided by the Surgeon's Mind and Conscience, from which, henceforth, it can never again be unholily divorced.

In the last century, in our own country, two men stand out from the rest—two Scotchmen, who gave a great impulse to the Healing Art. Brothers by blood, the HUNTERS were also of like tastes and industry, and nearly of equal genius, though JOHN excelled by the acuteness of his penetration and the universality of his views. Both when young were Surgeons and Anatomists, toiling in HARVEY'S "workhouse," and WILLIAM acquired his fame in practice as an Accoucheur. Both were illustrious by the Museums they created; one of which has since become, by State-purchase and the subsequent labours of RICHARD OWEN—indeed of more than one kindred mind—supported by the liberal subsidies of the College of Surgeons, the most glorious appanage of a great Profession that the world has yet seen; and the other is in the City of Glasgow, to which the munificence of its founder bequeathed it, with an endowment for its maintenance.

JOHN HUNTER was so largely employed during many years in applying his knowledge to the relief of human ills, that it is indeed marvellous how he could have at the same time laboured so hard in the general field of the Sciences of Life. But (given his mental capacity, zeal for his subject, and the pauseless industry that sprang from that zeal, and overbore the instincts which must have often yearned for repose in a life of great anxiety and suffering) this double labour, doubly prolific, which since the time of HARVEY had hardly been seen united in any one man, is to be explained by the mode in which his mind ever carried physiological principles into the details of daily practice, and sought in return, by the study of those details, to illustrate and advance his general views of the processes of life. Had the two fields of thought been in his estimation distinct and separate, he could not have achieved in each so great a victory. In each, it will be found on examination, his success depended largely on the real union which he, more than any of his contemporaries, or even of his predecessors, recognised to exist between them. English surgery and English medicine, in all their departments, have been since strongly coloured by this principle. This, indeed, is the abiding lesson which his life and labours have imparted to those who succeed him in the noble function of ministering to the wounded and sick, in his own country and throughout the world.

The HUNTERS may both be regarded as types of what the great masters and leaders of the Healing Art should be. They were anatomists; they were physiologists; they were pathologists; not by second-hand learning from the tongues or pens of other men, though this they did not despise, but by truth-loving observation and interrogation of Nature herself, in all her haunts of health and of disease; admitting no veils of limitation to be drawn by fashion, or caprice, or selfish interest between provinces and things essentially akin, but taking in *the whole scope of the Art as one great and ample field of noble study and beneficent activity*—one by the unity of man's body, to which it yields a voluntary and loving service; one by the identity of the methods of research by which the secrets of that body (whatever secrets, and of whatever part) are to be disclosed; one by the common aim and intention of all treatment, internal or external, remedial or preventive; one, lastly, by the simplicity of the moral attitude which should stamp us all as members of one body in our relations towards one another, to individual patients, and to the community among which we labour.

Gentlemen, I look upon the present meeting, comprising native members of every branch of our profession (and would that we could welcome, in future years, many more brother members from other lands!), as one representing the idea most needing to be insisted on amongst "doctors" at this time and in our own country, and which, I am persuaded, men like HARVEY and the HUNTERS would have been foremost to assert and act upon—the idea of *the oneness of our common calling*. And can we aver that there is no need to advance this idea? For, could we imagine these great ones of the past to be still with us, what special encouragement or opportunities for his cherished pursuits, we may ask, would HARVEY now find in his own favoured College of Physicians, whose welfare and improvement, we are told, "was the chief object that occupied his mind for several years before his death," but where "solemn lectures on surgery" are no longer given; where there is no anatomical or chirurgical work performed; and where no "repository for simples and rarities" exists, such as he fondly hoped by his benefactions and his example to have founded; even no museum of morbid anatomy, such as BAILLIE and BRIGHT would have longed for. On the other hand, should we be likely to find HARVEY, a Fellow of the College of Physicans, admitted to demonstrate the motion of the heart and blood in the Hunterian Theatre? Could WILLIAM HUNTER, having become, as he did at the age of thirty-eight, a Licentiate of the College of Physicians, and not being longer "in actual *bonâ fide* practice as a Surgeon," share in the councils of the Hunterian College, or in the love-labour of its Museum? or could he adorn its chair by his eloquence? Finally, could his greater brother, immortal by his 'Treatise on the Blood,' but being "only a surgeon," find entrance, consistently with existing usage, to discourse on that great theme within the walls which derive their chief glory from the Discoverer of the Circulation of the Blood?

It would ill become me, humble as I am, and feeble in grasp of thought, to utter or imply anything in the way of censure of these venerable corporations, which, with all their human imperfections, have done, are doing, so very much to adorn and advance, each its own side of our common profession. And, if neither of them has yet found itself at liberty to esteem of subordinate importance those class and college interests, those "rights and privileges," which a former age fenced in by forms of oath now generally disapproved of (whatever useful purposes they may once have served), it must be freely acknowledged that much has been effected by both in many ways, in recent years, to approximate to a policy more liberal and large, and certainly one more likely to secure the class interests themselves by engaging for them, so far as they are good and useful, the support of the whole profession.

Some minds abler than my own may indeed doubt whether the time be yet fully come for any large attempt at consolidation or union of these and other kindred bodies. We may be deemed to be still in a transition period, in which we must be content to work a little here and there, as we may, towards a better organization and truer views. I know not. But I must express my own conviction that the old rivalries of "physicians" and "chirurgeons" are now laid asleep in the breasts of all men of sense; or that, if they survive at all in our ampler day, it is only in some remnants of the traditional policy of the council-chambers of corporations, the vast majority of whose members are now too enlightened to harbour them much longer, against the broad and well understood interests of a whole profession. I am persuaded that the leading minds of both the more powerful corporations are in accord with the great bulk of thoughtful medical men throughout the three kingdoms, that these great and noble foundations, so far as they retain, in their constitution or in their forms, traces of the antiquated prejudices and narrow notions of an age long since past, should mould themselves afresh to suit the wants of a more instructed time, when the medical world, being older and much larger in numbers, is also more highly educated and wiser than before. The whole professional body has a perfect right, most of all in our progressive England, to see the Institutions which are its own made conformable to the wants of a period of unexampled social activity and advancement, when all the old impediments to intercourse are vanishing day by day as by the touches of an enchanter's wand; and when there are spread everywhere over the land able and intelligent members of our profession, whose co-operation should be invited and carefully organized, not only for the satisfaction of their own just wishes, but still more for the sake of the immense impulse that would thus be given to the prosecution of those common objects, which it so much imports us, as a scientific and professional community, to pursue.

And here I trust it may not be out of place to call before us for a few moments the memory of four men, from whom, had they been spared to us, a comprehensive view of all interests, judicious counsels, and a liberal course of action, might have been expected. It cannot, indeed, be truthfully said that their loss is irreparable; for in England, no man, however valuable, can long be missed. Their room will doubtless be supplied; but to allude to the living might be invidious.

Benjamin Collins Brodie* was eminently a man belonging to us all. A great surgeon, he was also a great physician, though probably he could not have been placed on the *Register* under that title. But he was a great medical surgeon, able to take in all the aspects of every complex case, to prescribe or to withhold physic, to operate, or to advise against operation. This capability arose primarily from what has been already suggested as its natural and legitimate source; he had zealously, as a young man, pursued the paths trodden by Hunter. He knew the body and its functions by the evidence of his own senses; he had meditated deeply on the inner phenomena of life; he had experimented on animals; he had enlarged the knowledge of his day. When the cares of an almost overwhelming practice pressed heavily upon him, he still did not desert Science, but became President of the Royal Society; and we owe to him, in addition to his many practical works, some most thoughtful contributions to physiological psychology. His scientific fame, reaching everywhere, is an honour to the medical profession, not alone to the Surgeons, but to us all.

Joseph Henry Green† was of too much capacity to be a Surgeon only. Early devoted to metaphysical speculations, for which his grand and subtle intellect peculiarly fitted him, he was also a wise, prudent man of action. His views of our Art were always extended and liberal. He embraced within his range all the world of life: he saw that *pure surgery*, so called, was a narrow and impossible speciality; he looked on disease as he found it in Nature, not capable of classification by any such test as that of the applicability to it or otherwise of one special kind of treatment, the chirurgical or manual. This last was to him a noble portion, but a portion only, of the whole Art. He was always anxious, like Brodie, to enlarge the basis of our profession, to elevate the standard of acquirement in its members, and to promote the sciences which belong to it.

I recall with gratitude the converse—in later years, the intimate and friendly intercourse—I enjoyed with both these considerable men. The third to whom allusion shall be made was in a nearer sense my loved and honoured friend and workfellow. Bred a Surgeon as well as a Physician, and always fond of surgical pursuits, a teacher of anatomy, a professor of physiology and of general and morbid anatomy, an ardent worker in the physiological laboratory, mastering in a real and practical manner all the details of his subject, ROBERT BENTLEY TODD* was both a voluminous writer himself, and a zealous promoter of literary and scientific work in other men. Then he became a clinical teacher and practical physician, indefatigable in the hospital wards, excelling some of his English contemporaries by the constant reference he was able to make in his teachings to anatomical and physiological facts and principles. Overburdened with engagements of various kinds, he yet always strove earnestly to promote in his own College, as well as elsewhere, the study of his favourite sciences; and he delighted to speak of those distinguished men, the associates or early successors of HARVEY, who had shed lustre on the College by their anatomical researches; particularly FRANCIS GLISSON, *omnium anatomicorum exactissimus;* THOMAS WILLIS, the author of the still classical work, 'Cerebri Anatome;' and CLOPTON HAVERS, known chiefly by his 'Observations on the Bones.'

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* Ob. Oct. 21, 1862.

† Ob. Dec. 13, 1863.

One who followed thus closely in the footsteps of HARVEY and the later British anatomists, whose mind, too, was remarkably sagacious and practical, and whose character was of force to leave a considerable impress on his generation, could not have failed to take an active and useful part in promoting union among us. I venture to think that, as his brethren come to look from a little greater distance on his career, he will rise yet more in their estimation; and his friends will add their testimony to the excellence of his heart and life, as his name and fine countenance are revived in their memory by the marble statue erected to his honour in the hospital which he laboured so successfully to found.†

You will anticipate me as to the fourth name I would mention—that of CHARLES HASTINGS,‡ so lately lost, so justly dear to the members of this Association. His great merit has been, that he first conceived a union of all the classes of our profession for common objects, and bore a principal part in advancing that union, under many discouragements, to the point we have already reached. I trust that his spirit of wisdom and conciliation, his large-heartedness, his breadth of view, will prevail in the counsels of our whole profession, and guide us all to a more complete concord of thought and action in whatever concerns the advancement of the objects he deemed so precious.

Let us now enquire, by glancing for a moment at one or two characteristics of the age in which we live, whether the time itself does not ask us to take a wide view of our calling, and to break through the trammels of a period of comparative immaturity. We see mankind everywhere becoming more and more *one family*, chiefly by the increase of man's dominion over Nature, through augmenting knowledge of her laws.

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* Ob. Jan. 30, 1860.

† King's College Hospital. Instituted 1839.

‡ Ob. July 30, 1866.

It is but a little while ago that GALVANI and VOLTA, experimenting on harmless frogs, in the highest spirit of Science, opened up new provinces of research, in which DAVY, and OERSTED, and AMPÈRE, and FARADAY, were soon to astonish the world by the rapidity and brilliance of their discoveries. And it seems to me but yesterday, for I was there,* that our WHEATSTONE, under the approving eyes of DANIELL,† passing the wire of his battery beneath the Thames, in presence of the lamented Prince whom we had then just welcomed to our shores as the Consort of our Queen, proved the possibility of the subaqueous transmission of those subtle vibrations, whose rate of travel we now know to exceed in a very high degree that of the mandates of the will along the nerves. Yet already, by a combination of enterprise and skill unparalleled, the magic twine unites two continents,‡ and man's thoughts, cyphered with unerring truth by silent-speaking symbols, in the last degree refined, and borne onwards by tender tremors of the metal, fainter yet far fleeter than Æolian whisperings, are traversing momentarily—even as I speak—the awful solitudes of Atlantic depths under vertical miles of incumbent water; where no sound, hardly light itself can penetrate; all heedless of the fogs and icebergs and mimic storms of the surface, 15,000 feet above. And soon the very globe itself will be woven over with an almost time-annihilating network;—a blessed harbinger, as well as sure eventual promoter, of goodwill and peace, of peace and goodwill to all mankind; and certainly a fulfilment of which we can none of us as yet appreciate the full meaning, of the loving purposes towards our race of the eternal and infinite God.

From the bed of those watery deeps, too, abysses no longer unfathomable, the finger of man has picked up evidences of teeming life *there also*, such, probably, as he now knows to have built up, by slow and gradual accumulation, in geological ages of unassignable remoteness, strata of the earth's now solid crust, tens of thousands of feet in thickness; and these in their turn contain the fragmentary but faithful records of series of organisms that have preceded the existing forms; and which seem to intimate with other collateral proofs (though I prejudge nothing), that life has been *continuous* on our planet from the first origin of organic being, through successive *generative* links of evolution, even down to, and into, the very times in which we live.||

Again, while we consider all this, and descry through HARVEY's "optick glass" of higher power, in the tiny elements of the gland of the insect or the gigantic

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* Viz., on June 22, 1843. (See *Times*, June 22 and 23.)

† Prof. DANIELL died March 13, 1844, at a Council of the Royal Society, at which the author was present.

‡ The first sub-Atlantic message passed on August 5, 1858, between the Queen and the President of the United States; the first message by the Atlantic Cable of 1866 on July 27; the present Address was read on August 9 of that year.

|| CHARLES DARWIN's 'Origin of Species,' appeared November 24, 1859; his 'Descent of Man,' March, 1871.

quadruped, an identity of essential structure with the corresponding parts of our own frame; and while we call to mind that, when our yet uncharactered members were seen already by the All-Seeing,* every one of us consisted wholly and merely of such tiny elements of structure; who shall say that the touch, the very touch of a mysterious organic kinship is not there, though it be as yet untraceable with certainty, as yet unprovable? The pedigree of man himself seems to be on trial before the Court of Science, and a true verdict may be given at no distant period. Let whoever loves Truth, and the God of Truth, await it with perfect calmness, though it should possibly fail to coincide with some prejudices of the timid. I venture to express an earnest hope, that our profession, which beyond others is brought to the threshold of such questions by the nature of its studies and by its habits of thought, and which I aver to be singularly remarkable for its love of truth and regard for religion, notwithstanding some vulgar echoes of old charges against us, will play a useful and moderating part, by reassuring less informed persons and quelling groundless alarms. Let us cast aside the foolish thought so flattering to a shallow pride, that man's dignity depends in any the least degree on the mode of origin of his material organization, whether in the individual or the race, any more than on the structure of his mature material organs; and not rather on that capacity for the reception of the Divine Spirit and for elevated commune with God and His Works, which comes with growth, but with which, at the earlier moments of his origin, he has not yet been endowed. His origin is what God has ordained it, and that is dignity enough. It may come to be worth considering, that man's nature may derive comfort, from an inversion of the dictum of the witty orator of the Sheldonian Theatre;† and that it may be a nobler, even a more Christian and a less Pagan view of our destiny, to find ourselves belonging, from the first, in the Divine counsels, to an Ascending rather than to a Descending series of the scale of being. We may come to acknowledge by Science, as we now accept by Revelation, that our bodily organization has sprung in the past from the dust of the ground, though only through Ascending forms; and as to our hereafter, although we know not yet what we shall be, we have the assurance that we shall one day share the Angelic Nature, in seeing God as He is.

Would that the Divines of England, and their Venerated Leaders, under the difficulties of their position, could be always mindful, *not in words only*, of the noble principle, so congenial to the spirit of our Church, that such questions, so far as they belong to the domain of man's intellect and sense, must and will be followed up according to the laws of his being and the onward current of human thought, in the interests of Truth only, regardless of fancied consequences! That they would all have faith in Science, that they would meet her, embrace her, and *not mistrust* her; being firmly convinced that her true results, when well proven and finally accepted by all competent minds, after full inquiry, become, so to say, *vox Dei!* That they would remember that such a Voice may be so potent as to rise to the height of that which once summoned an Apostle to cast off his most rooted prejudices, and to exclaim, "What was I that I could withstand God?"* While questions of such breadth and importance are pending, it must surely be prudent for them, in the interests of both truth and religion, to hold an even mind. Far from yielding to unworthy fears of the divine faculty of reason, and abusing those who are honestly employing it within the sphere of its proper activity, let them rather call down a blessing on so good a work; having a Faith, above fear, in the certain victory that awaits both Reason and Religion —both God's precious gifts to man in his darkness, and both certain to harmonize at length in Him! Oh!

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* "Thine eyes did see my substance, yet being imperfect: and in thy book were all my members written; which day by day were fashioned: when as yet there was none of them."—Psalm cxxxix, 15.

† "What is the question? It is now placed before society with, I might say, a glib assurance which to me is astonishing—the question is, is man an ape or an angel? Now, I am on the side of the angels."—Right Hon. B. DISRAELI, at a meeting convened by the Lord Bishop of Oxford (WILBERFORCE) in the Sheldonian Theatre, Nov. 25, 1864. See *Times*, Nov. 26, 1864.

> "Let knowledge grow from more to more,
> But more of reverence in us dwell,
> That mind and soul, according well,
> May make one music. . . . . . "†

Turning now to touch lightly on some of the advances of medicine in recent days, let us remark how inseparably they blend with, and mutually illustrate, the general progress outside our own immediate province. They may be conveniently comprised in two words, *scientific insight* in our work of Healing: the actual conditions of the body, in health or unsoundness, having become more easily distinguishable; their mutual play and connections better understood; and our means of profitable interference at once more numerous, more definite, and more manageable.

Before a Society so completely informed as you are, gentlemen, I feel it unnecessary to attempt to make good this part of my programme by laboured argument or lengthy illustrations; examples are only too abounding. HARVEY had heard the healthy sounds of the heart, but its morbid sounds inform us now of the nature of its structural defects. The sounds of breathing must countless times ere this have met the ear, but it was reserved for an illustrious Frenchman in our own days to study them, so as to enable every tyro often now to say what is the state of those great organs, hidden from our view, but so indispensable to life. And so with percussion. Nay, with our eyes we can now behold for the first time in its living acts, that marvellous mechanism in its most exquisite and joy-inspiring movements, as well as when it is oppressed by disease, which stands as a sentinel at the orifice of the air passages, and on which the voice and speech primarily depend. And need I advert to other applications of optical mechanism, or recount how one has called forth the other, until the various internal surfaces and structures, particularly those of the organ of sight itself, are now open to hourly survey, to scrutiny most exact and delicate, so that often even the pulsation of the smallest arteries or veins and the physical conditions of the capillary blood-vessels, with almost the earliest and slightest signs of morbid change may be detected and made available as guides to treatment? Much might be said under this head. Diseased states thus submitted to the faithful eyesight are seized on by the mind with a vividness that is of inestimable value to the practitioner, in framing his conclusions as to treatment; and he can judge, too, by the direct evidence of sense, how far to continue to follow up these. In a word, all the advantage the Surgeon has hitherto had over him who deals with concealed diseases, in that he has had ocular demonstration of his facts, the Physician now enjoys in regard to many internal organs. The Surgeon also participates largely in this expansion of our field of view, while a collateral result is that the Physician in many instances finds himself under the dilemma, either of undertaking operations strictly surgical, or of abandoning some departments of treatment and some important organs that custom has hitherto assigned to his care. Many have had the good sense to consider simply their patients' advantage, and not the punctilios of a class; and thus there has been a considerable, and, as I regard it, a very satisfactory demolition of old and artificial barriers between different grades of practitioners, which the future progress of Physical Diagnosis must still further tend to promote.*

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* Acts xi. 17.

† 'In Memoriam.' Introduction.

Take another example. By means of that modern optical triumph, the Compound Miscroscope, which takes us, as it were, among the very elements of form and the rudiments of organic structure,—a world we are apt to lightly regard, though it has infinite uses for us, as it has infinite beauties,—by this an instructed practitioner, even one not highly gifted, but only conscientiously alert and observant, can say with confidence of an organ deep in the wasting frame before him, beyond his touch, out of his sight, which emits no sound, and is the seat of no pain, "This gland has been certainly passing insidiously through this or that important destructive change; it is now so and so. I can accomplish this, or probably only this, for its relief, and this, or this, will be the end."

And, not to weary you, gentlemen, with more examples from the field of diagnosis, the results of Chemical Examination, frequently seconded by the microscope, need only to be alluded to in order to take their eminently important place in this imperfect sketch, by the side of the other aids to physical investigation of the signs and footsteps of disease, conferred upon us by modern science.

As to the intimate nature of disease and of health, *modern Physiology* is a platform on which all practitioners have an almost equal footing; where they meet and cross each other at every turn, and find everywhere the opportunity of a community of thought and action. All admit that disease is such a departure from a state of health as oversteps those undefinable limits which the organization will bear, without strain, or curtailment of its perfection. But these are not now such vague words as they might once have been; for vivid light has been thrown upon many of the abstruser problems that formerly perplexed us; the details of the interwoven structures and of the complex functions of our composite frame have been zealously and perseveringly traced by some of the acutest observers and of the keenest intellects that have ever lived; with a harvest of results so plentiful, so reliable, so mutually illustrative and on the whole so marvellous, as to make very much of the knowledge of even the last generation seem antiquated and obsolete. And we may accept it as a truth, that every step forwards in our knowledge of the healthy body, so it be real, must lead us right onwards, too, towards a better understanding of disease; and if of disease, then also of our power of counteracting it, whether in the way of prevention, alleviation, or cure.

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* Those who have to treat the various classes of disease here referred to, and which will be at once recognized without a particular enumeration, must be forcibly and directly convinced how shallow, superficial, and merely conventional, are those distinctions between different classes of practitioners, which custom and convenience indeed largely sanction, but which should on no account be allowed to exert any influence whatever in separating from one another within the lines of their common profession, the honourable followers of the same noble calling.

As to *modern treatment*, I shall only remark, that the direct and obvious tendency of all recent progress has been to make it more rational and more simple—that is, more appropriate, first, to the precise conditions more correctly recognized in each case; and next, to the degree in which interference on our part is found likely to prove advantageous or otherwise to the sufferer.

No conceit of our great advances in the *Medical Sciences*, however, must beguile us into assuming that *Medicine itself* is *a Science*, or can ever become one, in the sense of our being ever likely to be able to practise it on principles unerring and exact. It is not in any true sense a Science, but *the application of many sciences, and indeed of all appropriate and available knowledge, of whatever kind, to the relief of suffering.* It is really an *Art*, as the Father of Medicine long since styled it; and woe be to those patients who fall into the hands of men, aiming at treating all who come to them and all diseases on some single, so-called simple, principle, which can really be no other than the negation of all good sense and of all the well-understood conditions of our Art. It is an Art, however, which, while it must always be pursued with the very closest regard to the individual facts of the case, must in the interest of each patient be pursued in a *scientific spirit*, for thus only can the facts be duly interpreted and our treatment suitably applied.

And it seems the special glory of the advances in Healing knowledge in our own day, that they are of a kind to supersede those vague, general observations by which a few rarely-gifted men could formerly as now, make sagacious, pertinent, sometimes true guesses as to the nature and more latent relations of diseases (though these gifted men ofttimes fell into lamentable mistakes), while the generality steered without accurate chart or compass,—or worse, under the deceptive guidance of some false, delusive, though vaunted, theory. While, in the uncertain and ever-varying phases of practice, we may none of us afford to disregard the aid of our own unwritten experience, or those general impressions left on our minds by a long series ot empirical observations, in which as yet no clue to a satisfactory explanation has been descried, we may rejoice that these late advances are at the command of all, who, being honest enough to desire to detect the nature of a disease committed to their care by a suffering fellow-creature, will, with ordinary intelligence, instruct themselves in the requisite, and usually simple, physical tests. So far as these extend, they are to be most highly prized. They bear the stamp of all true knowledge in being useful, available, and not apt to deceive; and having been once acquired, they become henceforward the inalienable inheritance of all mankind, and doubtless the starting-point for future similar conquests.

The subject of *Anæsthetics* is too apposite for the general drift of the present Address to be altogether passed over in this place, though it is hard to mention it and not to pursue it to the exclusion of all else.

Dim notices of the use of medicinal agents to prevent pain in surgical operations are not altogether wanting in very early times; and the desire and hope of finding some means for effecting this was certainly felt by more than one person during the last century. Even a method by compression of the nerves was actually tried in one of the London hospitals. But our present universal use of this eminent blessing to suffering human nature is the result, first, of the progress of pure science, not medical; then, of the application of pure science by men devoted to particular specialities of practice: and both hemispheres share the glory of it.

Let us look at CAVENDISH, PRIESTLEY, and LAVOISIER, at work in their pneumatic laboratories; at BEDDOES, with young DAVY, in Bristol, trying to make inhalation of gases useful in medicine, inhaling laughing-gas, and noting its effects; a public lecturer at Boston, in America, nearly fifty years afterwards, exhibiting its well-known effects to an audience, among whom was a Surgeon-Dentist; at the sudden idea of this one to apply it as a remedy in his own case, for he was tormented with a toothache. It succeeded; but afterwards, when he had urged its adoption on a great operating surgeon, and it had been actually several times tried, the uncertainty of its effects caused it to be completely abandoned. But the idea had been too intensely impressed on some lookers-on to be ever again lost sight of. FARADAY had already long before shown the great similarity of the effects of the vapour of ether to those of laughing-gas, and this was being familiarly taught to students in chemistry. But nearly two years still elapsed ere another Surgeon-Dentist, who had been present on the former occasion, tried the ether, and found it to succeed so perfectly, and to be so manageable, that he at once proclaimed his discovery, and it was soon adopted by the surgeons of all countries.

But now a Pharmaceutical Chemist of Liverpool, at the instance of a more gifted mind, suggested another substance, a product of modern Chemistry, discovered simultaneously in Europe and America sixteen years before, which had been medicinally used, and even its name philosophically settled according to the analogy of its exact constitution, by one of the first chemists of France. The gifted man was an Obstetric Practitioner of Edinburgh, whose fame, already world-wide, will not rest hereafter solely even on so great a fact. After applying it in his own department of practice, the adoption of chloroform by surgeons, to the gradual exclusion of ether, rapidly followed; and all mankind will profit by it until, in the sure progress of the Art, some other anæsthetic shall be found, without even the slight inconveniences of this one.*

In reviewing the subject of anæsthetics, we cannot fail to be struck by two pregnant facts. The first is, that while Surgery has chiefly felt their influence, and its practice has been modified by them in a remarkable degree, Surgeons have been but passive recipients of the boon, which has been brought to them from other quarters, and even from a side branch of their own specialty, which some great ones among us have sometimes thought scorn of. The other is, that the noble sister Art of Physic (considered also as a specialty) has had no part or lot in this greatest of the applications of modern science to the alleviation of man's bodily pangs. I must, however, except Dr. BEDDOES, and cannot omit to mention with grateful appreciation the important share borne by the late able and amiable Dr. SNOW, both in the theoretical and practical parts of this great subject, as well as the recent labours of Dr. RICHARDSON.

In this instance, as in almost, if not quite, all that most distinguish the modern Art of Healing, we see it fostered and advanced, not to say transformed, by the influences of General Science in departments apart from, and beyond ourselves, combined with those of the Special Sciences, which may with some propriety be called medical and practical, because they are prosecuted mainly by men engaged in practice, and with the object of applying them in the treatment of disease. Let not, however, individual promoters glory, or indeed a great number leagued as a Profession, for that would be even less reasonable. It would almost seem that as "the Earth bringeth forth fruit of herself, first the blade, then the ear, then the full corn in the ear," so the world in our time is reaping results all valuable for the good of mankind, which have been long, and in various modes and places, a preparing, and in contemplating which our feeling should be rather one of thankfulness than of exultation; and this feeling may induce us sometimes to ask ourselves, "Can we do anything now, and in the future to help on, by united action, the harvests of a still brighter hereafter?"

This leads me to refer to the actual distribution, at the present day, in this and other civilized countries, of our professional power or force.

The immensity of the field of medical science and art is such, that no one mind has ever been able to embrace it all, and the daily enlargement of it in all directions must render it more and more difficult to do so. Hence the great specialties of Medicine and Surgery, however impossible it may be to draw a precise line between them, or to assign to either of them in an exclusive manner many large departments of practice, have long existed and must continue to prevail. The grounds for them lie (1) In the necessity for a division of labour in large communities (large by concentration of numbers or by facilities of intercourse); (2) In the somewhat equal proportions of grave and serious medical and surgical diseases, so called, under the circumstances of human life; (3) In the varying tastes of individuals, causing men to confine themselves, more or less, to one or other of these main divisions of practice. But the great majority of medical men, including those grand services of the army and the navy, must be ready to undertake all treatment, since the exigencies of society require it of them.

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* Guided by a more exact knowledge of the special advantages and disadvantages of each, we use at present (1882) laughing-gas, ether, chloroform, and some other compounds, either singly or in combination, according to the effects wished for in each particular case. The search for a more perfect anæsthetic should still, however, be ardently pursued.

Now the very same causes which have developed the Healing Art for ages under two principal divisions, have within a century, and especially of late, led necessarily, and by the very extension of the fields of knowledge, to the multiplication of subordinate branches, often just as impossible to define by strict limits. On these a very few remarks are all that the time admits of.

Specialties, then, are natural products of a period of progress, and of certain favourable external conditions of society, and as such should be allowed free course to develop themselves according to their tendencies. The policy of the profession towards them should be always to retain them within its bosom, to hold them to their connection with the whole, of which they form a part, and only to seek to restrain their growth and action, when it disposes them to an isolation, pernicious as regards their own usefulness, alien to the comprehensive spirit of our Art, and a violation of our unity as one body.

Medical men, acting under some common impulse, are apt, like any others, to take a one-sided, or what is sometimes called a professional, view of whatever new proposal seems to affect them as a class, or in a large number. Let us, however, consider that our ends coincide with the good of mankind, and that in estimating the good or the evil likely to be done by new specialties, we should appeal to no other standard than the public benefit—is this or that suggestion for the advantage of the community in which we minister? Our own credit as a body, and generally our individual prosperity, will be found in the general good; and, if otherwise, we should gladly yield it up to this.

Hence there are strong grounds for allowing specialties, whether promoted by smaller or larger numbers, to make progress according to their natural divergencies and powers of maintaining themselves. Some may originate on an insufficient and unreal basis, started, perhaps, by some supposed individual interest, and sustained by some strong personal bias, talent, or local circumstance. These will fail of themselves if they be left alone; and whatever harm they may do in diverting benevolence from more healthy channels, or in wasting time and opportunities, these are probably smaller evils than the creation of a feeling in the public mind, with any degree of reason, that we are narrow, or opposed to the progress of our Art.

What may be styled the *natural Specialties*, are those devoted to mental maladies, the obstetric, ophthalmic, and some others. These generally have reference to the natural distribution of organs in the frame, or are such as men readily accept, and see the propriety of, in their being manifestly for the convenience of patients as well as practitioners, and conducive to the advancement of knowledge. These are likely to increase in number, and to strengthen their footing. They should be held bound to the professional body by every available tie. Two things have given me pleasure in this point of view ; the one that the College of Surgeons saw the wisdom some years ago of allying the Surgeon-Dentists of England to themselves by suitable links of connection ; the other that the great library of the College of Physicians was lately the scene, under the auspices of its beloved and honoured President,* of one of the most astonishing historical displays of the mechanical appliances of the obstetrical branch of the Art ever collected in one room. A happy augury, I thought it, of a larger and grander union, in time to come, of all branches and all departments, under some single, ample, noble Portico!

Were the *whole profession* thus at one with itself, there are many weighty objects which it might labour for with tenfold vigour and effect. I am content, for my part, to regard as of very secondary importance all attempts to obtain political influence or the recognition of merit by titles, whether personal or corporate. For I am well convinced that, whatever may be worthy of our ambition in this respect (and it does not seem much), will follow of itself, and without our efforts, if we are true to ourselves in a higher, and, indeed, our proper, sphere, *by striving to become more useful as practitioners, wherever we may be*, either in our private rounds, where most must toil, or in some more public station.

With regard to our own better organization, it must of course be worked out by ourselves. We alone understand our needs; and the State cares little or nothing for what does not directly concern the public health; although we must acknowledge that it has shown itself, on many occasions, ready to forward our wishes, when these have been suitably advanced. The institution of the Medical Council is a transitional step of immense import for our future unification, no less than the work performed by that body in the preparation of a common register of all qualified practitioners, and in the publication of a 'Pharmacopœia' for the whole kingdom. Its beneficial influence will likewise be gradually felt in better arrangements for admission into the profession on a uniform basis.

But there are many functions, in connection with the Government, which so great a profession as ours might rightly ask to perform through its own well-appointed organs; in which, as a body, it now takes no share whatever; which are at present accomplished irregularly, almost as chance or caprice may determine, by a reference, either to one or other of the corporations, or to some individual selected by the Minister, whose very name, perhaps, is not known, and who, therefore, practically, is not responsible to his own profession for the advice he may tender. By degrees, indeed, of late years, as the care of the public health has more and more engaged the attention of Parliament, this want has been in part supplied by the appointment of medical officers for special duties in governmental departments; and most ably have these performed their duties, as the documents from time to time issued by the Board of Health, under the Privy Council, among others, amply testify. And the labours of the Army Diseases Prevention and Cattle-Plague Commissions illustrate in another way how the services of medical men may be most usefully elicited on special occasions or emergencies. More might be added to the same purport. A complete and recognized organization of the entire profession, however, would apparently be a measure of great importance to be aimed at, in reference to our relations to the State.

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* Sir THOMAS WATSON, Bart., F.R.S., now, 1882, most venerable, most honoured.

But leaving these more public questions, and looking at the whole nature of our position, we may fairly ask ourselves whether in our corporate capacity, as a body of men concerned with such great human interests, we may not hope to do more than we have hitherto done to help forward those interests, for the advantage of our own day and of those who are to follow us. We have a grand inheritance from the past; we should hand it down much amplified to our successors.

Individuals have done, are doing, will continue to do much. But I speak of the direction of a common endeavour, devised by forethought, tending to well-considered objects, and sustained by the united will of an enlightened, numerous, and, on the whole, powerful professional body, to promote and advance those branches of knowledge which lie at the foundation of a rational Art of Healing.*

I am not here to flatter any man, least of all to commit the little less than crime of the huge flattery of my own class, to the lowering of what should be our higher aims; and I say, with all love and respect for my fellows, and with a deep sense of my own short-comings, that we are not doing, as a body, what we might do in Britain to extend and deepen the scientific foundations of our Art.

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* The establishment (1882) of the "Association for the Advancement of Medicine by Research," must be hailed as the first serious attempt in this country to bring the powerful influence of the Medical Profession to bear, as a whole, on the systematic and continuous cultivation of this most important domain of knowledge. It is satisfactory that so many persons eminent by intellectual gifts and in science, and of the most enlightened humanity, are co-operating in the work. The author must record his thankfulness at having been permitted to share, however humbly, in a design so much in accordance with the sentiments to which he had ventured to give imperfect expression in this address sixteen years before.

The illustrious CHARLES DARWIN, shortly before his death, thus wrote:—

"Down, Beckenham, Kent, March 20th, 1882.

"SIR,—I am much obliged for the honour of your invitation to attend the meeting at the College

In our corporate capacity, we ought to foster especially those departments of research which are least likely to be undertaken by individuals without such encouragement; which, indeed, can hardly be prosecuted at all without means and appliances beyond the ordinary reach of individuals. We need in England the public open establishment of means and apparatus for original research and observation, *especially for our younger men*, in the sciences ministerial to medicine, particularly physiological and pathological laboratories and for organic chemistry. These should be in part connected with Museums, Medical Schools, and Hospitals. The lay governors of great hospitals should be moved to consider it as one of their most urgent functions, to see that no unnecessary waste of the precious means of improving knowledge, placed under their keeping, occurs.

The progress which recent years have witnessed, points with sufficient clearness to the direction in which the next steps may be most profitably taken. It is in the field of exact scientific investigation into questions and problems which the latest advances have opened to view. Here each new fact and principle, patiently grounded on previous knowledge and established beyond dispute, though it may for a while appear an idle and unimportant addition to the common store, may fructify hereafter into some solid and useful generalization, applicable, in the most unexpected and startling manner, to the increase of human happiness and the success of our cures.

In any step taken by the whole professional body for the encouragement and promotion of the medical sciences, we should not, of course, look for immediate results of that kind termed in common language *useful*—that is, having an immediate and obvious application to some present use. We remember that great uses may long lie dormant, and at length dazzle us by their splendour. *Witness chloroform.* Individuals are naturally prone to pursue studies which appear to them most likely to be crowned by an early result. Few have time or opportunity to labour perseveringly for any far-off or uncertain result, and out of mere love of knowledge; but those who desire to do so should be most of all helped on and sustained. As a body, we might have a settled policy, and look further and deeper. Such is the nature of our studies, that at present real advances are to be sought in depth rather than in extent of work. It is only by going deep that we can hope to reach central relations, and such principles as may be at the same time simple and reliable; not

"of Physicians on the 28th. I feel a deep interest in the success of the proposed Association, for "I am convinced that the benefits to mankind to be derived from basing the practice of medicine "on a solid scientific foundation cannot be over-estimated.

"I therefore regret much that it is impossible for me to attend the meeting on account of the "present state of my health.

"I beg to remain, Sir,
"Your obedient servant,
(Signed) "Charles Darwin.

"To Sir William Jenner, Bart., M.D., F.R.S., &c.,
"President Royal College of Physicians."

simple by the fallacy of an incomplete view. We should encourage, among the less immediately useful matters of scientific research, such kinds as experience reasonably shows to give promise of great and wide though more remote benefits. The Royal Society was founded simply "for the promotion of natural knowledge," and what results for mankind has it not aided in achieving!

In a word, we have the certainty, from all history and from the nature of the thing, that out of knowledge will flow useful application; and well instructed men now-a-days will not cavil or sneer at even the least advance, so it be real, into the realms of the unknown in natural phenomena, because it bears no immediate fruit, or gives no present earnest of profit. The radiance which illumines will ever be found also to warm and to cheer man's life upon the earth; and this is especially true in the medical sciences, prosecuted as they are by men whose whole habit and tendency is *to apply knowledge.*

The time is too short for me to attempt even to enumerate the lines or provinces of research that might be thus encouraged; but there is one subject on which a few words may not be inopportune at the present time.

There is a sentimentalism, which I shall venture to characterise as in some of its developments not robust or manly, not morally sound or grounded on right reason, which is inclined to bring popular indignation, excited by speeches at public meetings, and by essays produced under an artificial stimulation, to bear on men of science desiring to investigate great principles in the doctrine of life, by experiments on living animals. Having formerly, when circumstances led me into this region of inquiry, and in the performance of my duty as a Professor of Physiology, taken part in such experiments, and knowing well how vast an accession of knowledge useful to man has accrued, and will certainly hereafter accrue, from such experiments, I should be ashamed of myself, and deem myself to be neglecting a moral duty, if I omitted to take this opportunity of protesting with all my force against the imputation of "cruelty to animals" sometimes raised against medical men on this ground.

As inheritors of the labours, and, let us hope, of the scientific spirit, of Harvey, whose works abound with evidences that the discovery of the circulation itself was largely due to such experiments, we should be untrue to our ancestry and to our convictions if we hesitated to uphold, publicly if need be, the lawfulness, the expediency, nay, the desirableness, of such experiments; and, as it seems also to me, if we failed in our corporate character to take more active steps than at present to promote these in their proper place and degree, among other kindred pursuits.

A society, respectable and praiseworthy when directing its shafts against the meaningless and selfish acts of vulgar and brutal natures, or when striving in various ways to diminish the pain inflicted on animals put to those human uses which general consent, no less than the widest view of all nature, sanctions, is no longer to be commended when it ventures to raise a prejudice against the refined and honourable inquiries of educated men, seeking to advance legitimately a branch of knowledge most nearly touching human interests of a lastingly high order. For every really forward step taken in the science of man's life is a part of that progress which is indisputably adding to the sum of human happiness, not only in the present time but in the future. It is only those well-meaning persons who are little acquainted with the necessary elements, and the excessive difficulty of such researches, and apparently still less with the motives of the higher class of scientific inquirers, who can presume to endeavour to thrust themselves into a province where no present abuse calls for interference. I think it would be wiser for the excellent persons in question to confine themselves to those spheres of exertion in which all good men and scientific men must heartily bid them God-speed, rather than wear the appearance of attempting to add to their *éclat*, as a popular society, by a foolish crusade against what can certainly be justified, and must even be applauded, by all well-wishers of their own kind, if we admit, as society seems inclined to do at present, that to apply animals to purposes useful to man is one of the manifest ends of their mutual relationship on the earth.

In the country of HARVEY, and in the bosom of the profession which derives so much glory from his name, in the country of JOHN HUNTER, of ASTLEY COOPER, and of BRODIE, there should be no doubt as to the free allowance of dissections of living creatures for the advancement, and also for the communication, of a knowledge so indispensable for our race and for every generation of it. It seems to me ill-advised and unwise to attempt to define too closely the limits within which such experiments may be performed or repeated; since those only can properly judge of them who have undertaken the honourable responsibility of prosecuting original researches in this field, or of handing on to others the methods and results of such inquiries. To the conscience and human feelings of these may safely be committed the discretion as to how far this exercise of man's prerogative over all the lower organizations may be carried, without the abuse of inflicting unnecessary pain.

Now that anæsthetics are in common use, physiologists, we may be sure, will be the first to employ them whenever the nature of their inquiry allows; and the public may be satisfied that—in Britain, at least—those who know most of the interior structure of the animal frame, and of the movements, of whatever kind, that are the manifestations of its wondrous life, would be the first to denounce the causeless infliction of one pang on the lowest of God's creatures. Let the indecorum, then, not be again committed of dragging such questions before miscellaneous public audiences, for which they are quite unsuitable. Let the opponents of legitimate experiments on the lower animals (and I believe they are few, even in the Society to which I have alluded) desist from a course which, however well intended, cannot be required for their chief objects; and which may expose themselves to the charge once brought against persons of an altogether different stamp, of stopping the gates of knowledge; neither going in themselves, *nor suffering those that are entering to go in.*

I intended, gentlemen, had my limits permitted, to have adverted to several additional ways in which, as it appears to me, a united profession could find opportunities of promoting scientific culture; of which a principal one might be the employing more speedy and extensive means of making us acquainted with the productions of foreign medical literature than have hitherto been attempted. Men of science throughout the world have a common field and common objects of pursuit, but not now as once, a common language; for most of us, translations only can supply the defect; and translations, unless tolerably full and promptly brought to us, are of comparatively little value. Nor can our weekly and quarterly journals, conducted as they are with constantly increasing ability, and all of them, I think, comprising a foreign section, do much to satisfy this particular want.

Our New Sydenham Society is worthy of all praise, but its sphere is too limited and its publications are restricted to its own subscribers; and these only 2,500, too small a number out of so great a profession. The original memoirs and works in medicine and the allied sciences bear a considerable proportion to the whole of the scientific productions of the world; and some idea may be formed of the number of these from the fact that the separate scientific memoirs and works of all countries, of which the distinct titles could be ascertained as having appeared between the years 1800 and 1863 inclusive, brought together under the authority of the President and Council of the Royal Society, reach the astonishing total of 220,000, while every year's produce is becoming greater than the last.*

The medical literature of Germany, France, Holland, and other continental countries, abounds in materials of great value to us, both as scientific men and as practitioners (as ours, no doubt, does to them). But unless we are kept fully aware, in each department, of the additions as they accrue, we are in danger of lagging in the race of improvements, and can hardly hope to do justice to our patients or to ourselves.

But, gentlemen, I must conclude. I would willingly have resigned into abler hands the task unexpectedly imposed upon me by your Council. Circumstances and my tastes have caused me for some time past to desire to play my humble part noiselessly in the world; and I have been less able than I could have sometimes wished to share even in the pleasure and the profit of professional gatherings. I have, therefore (more perhaps than some men), looked somewhat as a spectator, from the outside, on many of the more public doings of our profession whose well-being, prosperity, and honour I yet esteem above all price, and am constrained by every motive to desire to promote. I must say that I have witnessed with delight every successive sign of a spirit of conciliation and approachment between the old, venerable, and most justly honoured, but still independent and detached—rather never yet united—corporate institutions, to which so many of us owe an allegiance undertaken formally by a solemn act. It has seemed to me that we have been weaker for good than we might have been; and especially for the furtherance of those beneficent objects, which no class will pursue if not our own, and none so well as our own; which, therefore, it would seem to be incumbent on us to prosecute by all the means in our power; and which have apparently been less thought of because of our divisions. Not real divisions of feeling, nor any wide or deep divergence of interests, but only a want of united action; through the continued existence, in too much of their traditional shape, of isolated institutions, which, in their present form, we have somewhat outgrown, and which seem to need some considerable rearrangement, if not consolidation, if they are to represent the altered state of the whole profession, such as it has come to be in our own age of astonishing progress.

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* Up to 1873 inclusive, 327,000.

I have now endeavoured to convey to you, I fear at too great length, my general impressions on this head, I hope without offence to anyone and with sincerity, certainly very inadequately. I have long looked upon this Association as the element in our profession out of which stronger bonds of union between all ranks, classes, and degrees, might be expected to grow, than out of any other—at least, at present; for it is framed on the most comprehensive basis, and is organised so that all interests in all parts of our common country might find their place and voice in it.

May it be more and more every year an arena where the wisely expressed objects of its Founders may be temperately, but steadily and earnestly pursued—above all, in a spirit of union! and may the leading minds of our profession, whose co-operation we so much require, and so highly appreciate, come more and more amongst us, to help forward that great and noble Art of Healing, to which, in one or other of its departments, the lives of all of us are devoted!

LECTURES

ON THE

PARTS CONCERNED

IN THE

OPERATIONS ON THE EYE,

AND ON THE

STRUCTURE OF THE RETINA,

DELIVERED AT THE

ROYAL LONDON OPHTHALMIC HOSPITAL, MOORFIELDS, JUNE, 1847.

TO WHICH ARE ADDED

A PAPER ON THE VITREOUS HUMOR;

AND ALSO

A FEW CASES OF OPHTHALMIC DISEASE.

By William Bowman, F.R.S.,
FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND;
PROFESSOR OF PHYSIOLOGY AND GENERAL AND MORBID ANATOMY IN KING'S COLL., LOND.;
ASSISTANT-SURGEON TO THE KING'S COLLEGE HOSPITAL, AND TO THE
ROYAL LONDON OPHTHALMIC HOSPITAL, MOORFIELDS.

TO

JOSEPH HODGSON, ESQ., F.R.S.,

LATE SURGEON TO THE GENERAL HOSPITAL AT BIRMINGHAM,

IN GRATEFUL RECOLLECTION OF EARLY KINDNESS AND ENCOURAGEMENT,
DURING FIVE YEARS SPENT WITHIN THE WALLS OF
THAT NOBLE INSTITUTION:

AND TO

JOHN RICHARD FARRE, M.D.

FREDERICK J. FARRE, M.D.

GILBERT MACKMURDO, ESQ., F.R.S.

JOHN DALRYMPLE, ESQ.

JAMES DIXON, ESQ.

GEORGE CRITCHETT, ESQ.

ALFRED POLAND, ESQ.

MY COLLEAGUES AT THE OPHTHALMIC HOSPITAL,

IN TOKEN OF SINCERE RESPECT AND ESTEEM:

THIS SMALL WORK IS

Dedicated.

LECTURES, ETC., ETC.

PREFACE.

The following Lectures were hastily put together, and were delivered nearly in their present shape, in the summer of 1847 (viz., on June 8th, 15th, 22nd, and July 6th), with the simple object of exciting in the minds of the pupils some interest in the study and treatment of Eye Diseases. They are quite elementary, and touch very briefly, or not at all, on many points, which could not have been suitably passed over in a treatise of more pretensions or of wider scope. It is matter of regret to the Author, that want of leisure has rendered it impossible for him, in this reprint of them from the 'London Medical Gazette,' to hazard any attempt at making them less imperfect than they are.

A paper on the Vitreous Humor has been added, which was published last year in the 'Dublin Quarterly Journal of Medical Science,' together with a few Cases of Ophthalmic disease, selected chiefly on account of their having some reference to the subjects of the Lectures.

A Tabular Statement has also been appended of the Cases treated, and the principal Operations performed, at the Ophthalmic Hospital during the last ten years. This has been compiled by Mr. Ledger, the intelligent house-surgeon to the Hospital, from the Annual Reports, drawn up by the Medical Officers, and regularly published by the authorities of the institution.

14, Golden Square,
March, 1849.

[Note.—A French translation of these "Lectures, &c.," by M. Testelin, with all the figures, was published by the Annales d'Oculistique, Bruxelles, Paris, Leipzig, 1855. Though much of what was original in them first appeared April, 1847, in 'The Physiological Anatomy and Physiology of Man,' Part III, Chapter XVII, "Of Vision," it has not been thought necessary to include that chapter in Vol. I of these "Reprints."]

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LECTURE I.

General view of the eyeball—its size, shape, and tension—Structure of the Sclerotica—Implantation of the recti—thickness at different parts. Of the Cornea—shape—surfaces—thickness—Is it a lens? Of the lamellated tissue—Number of superposed lamellæ—Tubular interstices—Union with sclerotica. Anterior elastic lamina—how tied down—Conjunctival epithelium—Posterior elastic lamina—Marginal plexiform tissue—its triple distribution—Circular sinus—Epithelium of the aqueous humor.

Gentlemen,—The benevolent founders and supporters of this hospital have ever been desirous that it should not merely minister (as it does so largely) to the relief of the poor of the metropolis and surrounding counties, but that its ample resources should be employed as means of instructing the rising generation of medical men in the very important class of diseases which are daily treated within its walls. I need not inform you particularly of the share it has had in enlarging and diffusing the knowledge of ophthalmic diseases. It will be enough that I refer, as evidence on that point, to the names of Saunders, Farre, Travers, Lawrence, and Tyrrell,—the distinguished men who, for more or less of the first forty years of its existence, were the instruments of its usefulness, and the main source of that amount of celebrity which it has acquired. Of these we can still number but one amongst our present colleagues: and I cannot mention the name of Dr. Farre, without a passing acknowledgment of what this institution owes to him, and of the honour I feel it to be associated with one so venerable and respected.*

It is our wish, according to our ability, to continue to make the Ophthalmic Hospital subservient to the same ends as heretofore. The number of patients considerably exceeds that at any former period, being now upwards of 7,000 annually, and these afford the means of studying on a great scale the several forms of disease which attack the complex and important organ of sight.†

The lectures which we offer are not intended to supersede the necessity of your observing, each one for himself, with minute and accurate attention, the realities of disease and the effects of remedies, but rather, by opening the subject, and acquainting you with the general outlines, to remove the first difficulties from your path, and to stimulate your minds with a foretaste of the pleasure which all will certainly experience, who devote themselves to the earnest pursuit of knowledge in the field before us.

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* To these distinguished names must be added that of Mr. Dalrymple, who is now retiring from the Institution after a service of nearly twenty years, during which he has contributed to raise its character by his excellent work on the 'Anatomy of the Eye,' published in 1836, and who is about still further to extend its reputation by an admirable series of coloured illustrations of the diseases of the eye.

† In 1848, upwards of 8,000. [In 1876, 21,000; in 1891, 25,500.]

In the arrangements for the present season the task has devolved upon myself of giving you some account of certain structures of the eyeball, which are of primary consequence to the practitioner, as being those involved in the operations he will be called on to perform, and also as being the seat of several of the more common, as well as severe, morbid actions which affect the organ. That you may form some estimate of the importance of that class especially which belongs to the *cornea*, I may mention a circumstance which I remarked with concern during a visit to that noble institution, the School for the Indigent Blind, in St. George's Fields. It was this—that a very large number of all the cases of total and irremediable blindness which those walls receive are the result of inflammations of the front of the eye, its transparent inlet having been darkened or destroyed by the ravages of disease, which we are *quite sure* might, in a great majority of instances, have been controlled by skilful and timely treatment. These cases occur amongst the poor—a class to whom the eye is, if possible, even more valuable than to the rich, because without it they can hardly obtain their daily bread, or enjoy the common comforts of existence—a class, too, among whom it is probable that most of you will be called on to minister during the early years of your professional life. More than this, I think, need not be said to impress you with the importance of the subject which is about to engage our attention.

It would be easy to expatiate on the utility of an exact knowledge of the structure of the body to one who desires to study that body in its morbid states; but I am willing to hope that such an argument would be almost superfluous; and at any rate (that I may not detain you any longer on introductory topics) I shall content myself with observing, that, though a man of genius has now and then become a great physician, like HIPPOCRATES or SYDENHAM, by an acute and persevering observation of disease, and of the effects of remedies, and without much acquaintance with anatomy, yet that the common voice of mankind proclaims that he who best knows the *mechanism* of the body, will, with a like study of the other departments of medicine, be the best able to comprehend the *actions* of that body, both in health and disease.

General View of the Eyeball.

The eyeball, gentlemen, as you know, consists primarily and essentially of a *sheet of nervous matter visually endowed*—that is, capable of being so affected by light, that, when duly connected with the sensorium, what we call *sight*, or *perception of light*, is the result. This sheet, which we term the *retina*, is brought towards the surface of the body to meet its appropriate stimulus; and the commissure of nervous substance which connects it to the brain and to the opposite retina is called the *optic nerve*. In front of the retina are placed *transparent media*, which, as a whole, refract the light so as to bring it to a focus on the nervous layer, which is spread out in a concave form to receive the more perfect image. The retina is supported behind by a firm resisting tunic, the *sclerotica*, which is prolonged in front of the transparent media, as a transparent, partly integumental membrane, the *cornea*. Between the retina and the sclerotica is a very vascular membrane, of a dark brown colour, the *choroid*, which is advanced behind the cornea under the form of a vertically-hung contractile curtain, the *iris*, in the centre of which is an aperture, the *pupil*, capable, by varying its size, of regulating the quantity of light admitted to the retina. To allow of the movements of the iris, the transparent medium across which it is extended, and which fills the concavity of the cornea, is a *fluid* one, the *aqueous humor*. Behind the aqueous humor and the iris is the *crystalline lens*, the most solid and highly refracting of the media, imbedded in the front of the third humor, the *vitreous*, which itself occupies nearly four-fifths of the globe, and fills and supports the hollow of the retina. To hold the crystalline in its place, the choroid is fixed to the outer case at the junction of the sclerotica and cornea, and sends inwards a circle of folds, the *ciliary processes*, which impress, and fasten themselves to, the vitreous humor all round the lens.

It is unnecessary that I should speak at present, even in general terms, of the mobility of the eye, of its outer protective appendages or of the source of its supply of blood. The limits to which I am confined oblige me to proceed at once to those points in the anatomy of the globe which more immediately concern our present object. And, first, of *the size and shape of the eyeball.*

Shape of the Eyeball.

The human eye, when carefully separated by dissection from the muscles implanted in it, and from the surrounding fat and areolar tissue, is seen to be about spherical in shape, with this exception—that the cornea which forms the front clear part, whereby the light has access to the interior, bulges somewhat beyond the rest, is more convex, and is the segment of a smaller sphere. The sphere of the sclerotica, however, is not absolutely geometrically true in all cases, or even generally. I have found it many times slightly spheroidal, with the longer axis sometimes transverse, sometimes longitudinal; and even other and more irregular departures from the exact spherical shape occur, the lateral regions occasionally presenting trivial swellings, chiefly between the muscles, and not affecting the integrity of the organ as an optical instrument. Behind, where the retina is spread out, the sclerotica is thickest and stiffest, most completely retaining its proper curvature even after it has been cut into small pieces; and it is interesting to observe how carefully the exactness of its curvature in the posterior region has been provided for in the construction of the eye generally in the animal series: in some instances by extraordinary thickness and density of the fibrous tissue; in others by the development of very thick or highly elastic cartilage, and even bone, in its stead.

Size of the Eyeball.

The size of the adult human eye varies within certain limits, as might have been expected. Nevertheless, as it is a part which, by reason of its complex mechanism, and the peculiarity of some of the textures it comprises, attains its complete development, like the internal ear, before most other organs of the body have reached their adult condition, these limits are very confined, if we except instances amounting to disease. Of many measurements which I have made, the general result is that the diameter of the sclerotica is from seven-eighths of an inch to an inch.

The transparent cornea forms by its anterior surface a portion of a sphere, the diameter of which is from $\frac{19}{32}$nd to $\frac{21}{32}$nd of an inch (that is, of usually less than two-thirds of an inch), and it often happens that the surface of the globe recedes, or is depressed, very superficially near the line of junction of the sclerotica and cornea. The cornea forms from one-sixth to one-seventh of the horizontal circumference of the whole globe.

In considering the size of the eye, I should guard you against judging of it in any degree by the size of the aperture of the eyelids; the latter, indeed, is that which most governs the *apparent* size of the ball, and is also of much importance to the practical surgeon, as enabling him more or less readily to manipulate in his operations on parts within the lids. Moreover, the cornea is often *apparently* smaller than it really is, in consequence of the formation of a ring of opacity close to its border in the declining stages of life.

Tension in Health and Disease.

The eyeball has naturally a certain tension, arising from the due repletion of the outer case with the tissues contained within. It gives a tight or resisting feel to the finger applied upon it, and the exact degree of this tension belonging to the healthy state it is essential for you to know, both that you may be aware of the resistance your instruments will encounter, and also that you may be able rightly to appreciate by the touch the departures from the healthy standard of tension which occur in the course of several diseases. When disorganizing processes have occurred in the interior, the eyeball frequently becomes soft, at other times hard, although, perhaps, the finger alone can inform you of these evidences of the impaired nutrition of the organ. Again, in inflammations of an acute kind attacking the globe, an unnatural hardness is perceptible on pressure, usually accompanied by that dull sickening pain which attends distension of the fibrous tissues, and referrible in this case, I suppose, in a great measure to the sclerotica and cornea. The unyielding nature of these coats occasions all internal distending forces—as vascular engorgements, fibrinous or purulent effusions, if their accession has been sudden and rapid—to react in the way of counter-pressure on the parts within, impairing their functions in the first instance, and soon irrecoverably destroying them, if allowed to continue unchecked. We have analogous phenomena in the case of other organs enveloped, like the eye, in a tunic incapable of hasty dilatation.

OF THE SCLEROTICA.

To proceed now to a more particular account of the sclerotica and cornea. And first of the sclerotica.

Structure of the Sclerotica.

The sclerotica consists of a very dense and intricate interlacement of white fibrous tissue. The surface is not glistening, like most other examples of the tissue, but dead white, by reason of the working up of its fibres in an irregular way, into a web which exhibits little indication of their course. In tendons, in fasciæ, even in the dura mater, a silvery lustre results from the parallel course of contiguous fibres, and the small creases occurring on these confer a satiny surface, which is extremely characteristic and beautiful; but this is not the case with the sclerotica. Those parts of it which are exposed to view, as the white of the eye, have no lustre of their own: the brilliant reflection of light is rather from the moist surface of the investing conjunctiva, set off, it is true, by the opaque white foil of this tunic behind. The fibres of the sclerotica, when unravelled from one another, and examined in minute portions under a high magnifying power, do not quite resemble those of tendon and fascia: they are more straight and stiff, less wavy, less connected: they also tear and break more easily, so that you cannot run them out into such long shreds as in the case of tendon or ligament. Nevertheless, they swell out and become semi-transparent with acetic acid or the caustic alkalies, just as ordinary white fibrous tissue. You can best see the characteristic differences I have now alluded to in the posterior part of the sclerotica of the Ox or Sheep. This much resembles the thick coat of the air-bladder of the Sturgeon, which I had once an opportunity of examining in the fresh state, and it is possible that it might even be made to yield isinglass like that structure. There is also a good deal of delicate yellow elastic tissue intermixed with the white in the sclerotica.

But although it cannot be said that the fibres of the sclerotica are arranged with regularity, yet they appear to have a more or less determinate direction from behind forwards in the hinder and middle portion; and we may also sometimes observe on the inner surface, after the choroid has been removed, an appearance of arching fibres, having their convexities turned forwards; and, moreover, the anterior part usually presents a different arrangement on its outer and inner surfaces, the fibres of the former being more circular, following somewhat the border of the cornea, especially over the insertion of the recti muscles; while those of the latter are more obviously directed forwards.

Mode of Implantation of the Tendons of the Recti Muscles.

With reference to this subject, I may allude to the *mode of implantation of the tendons of the recti muscles into the sclerotica.* These, as is well known, become flattened and expanded somewhat before joining the sclerotica; and I believe it is a common opinion that they join side to side, and spread out as a kind of external investment to the front of the sclerotica, advancing up to the cornea, and constituting the white tunic which is visible between the lids. I do not find, however, that this description, as regards the human eye, agrees with nature. On the contrary, the tendons of the recti appear to be truly implanted into the sclerotica, penetrating its substance, so as to be buried from view, and leaving its exterior layers exposed under the conjunctiva. I have several times traced the continuation of these tendons for a considerable way forwards in the middle substance of the sclerotica, to a certain extent making a division of it into an inner and outer layer, and gradually becoming lost to view, as they break up into laminæ, and blend with the neighbouring structure very near the margin of the cornea.

Thickness of the Sclerotica at different parts.

It may not seem very important in a practical point of view to inquire into the relative thickness of the sclerotica at different parts of its extent. It is interesting, however, in a physiological sense, especially with reference to comparative anatomy, and is really not without its practical bearings, since we find the effects of certain morbid actions to be limited or otherwise modified in correspondence with it. The sclerotica is thickest behind, for the support of the retina, and for the perservation of its due curvature at the most material spot. Around the foramen by which the optic nerve enters to join the retina, and which is near the bottom of the eye, the sclerotica is about $\frac{1}{25}$th of an inch thick. Hence it becomes thinner forwards as far as to a quarter of an inch behind the cornea, where it is only about $\frac{1}{40}$th of an inch thick. From this line to the cornea it again increases in strength, and is from $\frac{1}{30}$th to $\frac{1}{35}$th of an inch thick, so as to be able to give greater support to some of the internal parts, which I shall have to speak of in a subsequent lecture. In the Monkey, and in many of the smaller Mammalia, I have found this front part the thickest of all.

The recti muscles being inserted as described, groove the sclerotica before entering it, and hence this membrane is rendered very thin immediately behind their insertion; hardly, in fact, being more than $\frac{1}{60}$th of an inch thick in those parts. These being, therefore, the weakest parts, are those which might be expected to yield earliest under any inward distending force, and accordingly I have observed that abscesses of the eyeball are prone to point in these situations.

While upon the subject of the insertion of the recti muscles, it may be mentioned that, in cases where the contents of the globe are diminished in quantity, as a result of pre-existing inflammation of a destructive kind, and the eye consequently shrinks to a smaller size, the softness of the organ allows the recti muscles to impress it in the lines of their transit, and to bulge it in their intervals, thus pinching it, as it were, into a quadrangular shape. In such examples the thinner parts of the sclerotica under the tendons of the recti, being pressed upon by those tendons, and unsupported from within, are sunk in or flattened.

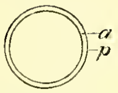
OF THE CORNEA.

We will now turn our attention in a more particular manner to the transparent portion of the outer case, the *cornea*, a part of which it would be difficult to exaggerate the importance in reference to the operative surgery, or the pathology of the eyeball, and which can hardly fail to attract your interest in a high degree, however imperfect my description of it may prove.

I shall not stop to enquire what light comparative anatomy, or the early stages of its development, might throw on the true affinities and nature of this structure, but will merely observe that there is some reason to suppose that the cornea, considered from this point of view, comprises two orders of parts—one belonging to the nervous vesicle which forms the earliest indication of the appearance of the eye in the early embryo; the other, and the larger, pertaining to the outer integument. I prefer, on this occasion, remembering the object before us, to take the cornea as we find it in the adult human subject, and to describe it, layer by layer, as it actually exist in those in whom you will be called upon to study and relieve its morbid states.

The cornea is nearly circular in shape, though we often find it wider from side to side than from above downwards. Its anterior surface is generally less extensive than its posterior, sometimes considerably so. The edge, therefore, by which it is continuous with the sclerotica will be bevelled, so that the sclerotica will overlap a little. Sometimes, on looking at the surface of a vertical section carried through these parts at their junction, we see the cornea received, as it were, into a groove of the sclerotica; but even here the hinder surface of the cornea is almost invariably the more extensive: and I cannot say that I have ever seen an instance in which the bevelling was reversed, so that the cornea should overlap the sclerotica.

The two surfaces of the human cornea are, as far as I can judge, perfectly parallel to one another; that is, their corresponding points are equidistant, and the substance of the cornea is of the same thickness throughout. This has been doubted by some anatomists, who have described the central part as thicker than the margins, and have supposed that the cornea was a meniscus-convergent lens, capable of magnifying objects. But the mode employed to prove this—viz., that of first dipping the detached cornea into water to smooth its surfaces, and then, holding it over objects, finding it act as a slight magnifier—seems open to fallacy, since the only way in which it can be conveniently held is with the convex edge downwards, in which position, the water still adhering would fall to the central part, and make a lens of it. But I have failed to find the membrane magnify when secured against this source of error; and, moreover, an exact vertical section of a recent cornea exhibits an uniformity of thickness. When the part has been macerated, it swells somewhat, and bulges less at the sides, where it is tied to the sclerotica, than in the rest of its extent. I need not observe that the cornea, though not itself a lens, yet acts as a powerful converger of the rays of light by virtue of the aqueous humor, which differs little from it in density, filling up its concavity in the natural state. That the cornea is not thicker in the middle is indicated by the phenomena of the disease called *conical cornea*, in which the weak or bulging part is always at or near the central region. In fishes the cornea is much thinner in the middle, to allow for the very projecting lens.



a, Anterior surface. *p*, Posterior surface.

FIG. 1.—RELATIVE SIZE OF THE TWO SURFACES OF THE CORNEA IN ONE INSTANCE.

The absolute thickness of the cornea is greater than that of the anterior region of the sclerotica, being, according to the measurements I have made, from about

$\frac{1}{22}$nd to $\frac{1}{32}$nd of an inch. These measurements exhibit considerable variety, which it is important for the practical surgeon to be aware of.

The first portion of the cornea that comes under our review is the *cornea proper*, or the *lamellated tissue.* It is this which forms the greatest proportion of the thickness of the cornea, and gives it strength and toughness. This is bounded externally by a peculiar lamina, the *anterior elastic lamina*, on which rests the *anterior* or *conjunctival epithelium*, and it is bounded behind by another peculiar lamina, the *posterior elastic lamina*, behind which is the *epithelium of the aqueous humor.* It is the cornea proper alone which is strictly continuous with the sclerotica.

Of the Lamellated Tissue of the Cornea.

That the cornea proper is lamellated has long been known, and may be shown in a variety of ways. If a flap be shaped out on its surface by superficial incision and then torn up, the surface of laceration will be nearly parallel to the outer surface, and in this way layer after layer may be removed, especially in the eyes of the larger domestic quadrupeds. The knife, too, especially if blunt, having once pierced this tissue, is found to pass more readily in a horizontal direction, at whatever depth. These are circumstances with which all should render themselves practically familiar, who propose to make the living eye the subject of their operations. This physical construction of the lamellated cornea makes it desirable for the surgeon, when about to penetrate the cornea, to thrust the knife somewhat perpendicularly into it, since the arrangement of the tissue tends to carry the instrument in a horizontal course.

The lamellated cornea is tough, unyielding, and almost perfectly transparent; and it is interesting to study the precise nature of its lamellæ, because there are facts which show that its transparency is very easily impaired by any derangement of their relative position, or by an increase of their natural tension. For example, if a thin vertical section of this part be made, and laid upon a slip of glass moistened with water, it remains transparent; but if you attempt to stretch it, in whatever direction, or to compress its parts into a smaller space, it instantly becomes milky and opaque. Again, if you squeeze a fresh and perfect eye between the finger and thumb, the cornea, it is well known, becomes immediately opaque in your hand, but quite recovers itself as you remit the pressure: and in all cases the degree of opacity is proportionate to the pressure you exert. This is a very remarkable experiment, and may serve to illustrate in some measure the opacity or haze of the cornea, which is apt to occur at an early stage of acute internal inflammation of the eyeball, attended with great engorgement of its vessels—a state also elucidated by what occurs in artificial injections of the eye, for when the vessels become gorged, and the globe tense and hard, the cornea invariably grows dim, and shuts off the iris from view.

Now, that the lamellæ of the lamellated cornea are not individually co-extensive with the cornea itself, is easily proved by a vertical section, in which we see the lines bounding the lamellæ to be very limited and interrupted, not extending far along the cut surface; the same view proves the lamellæ to run into one another at very numerous points throughout the entire cornea, so that the interspaces are very limited in their superficial extent; though their number is correspondingly great. Moreover, in tearing up a flap in the way I have already alluded to, innumerable connections between the lamellæ are seen to be torn through, and the surface exposed is not smooth, but covered with numberless minute lacerations of tissue. It would, therefore, be most correct to say that the strength of the tissue lies in a horizontal rather than in a vertical direction—that the horizontally-extended elements are thicker, and stronger, and less easily lacerable, than the more delicate, more fragile, vertically-placed elements which connect them with one another. Now if we endeavour to count the superposed lamellæ, it is evident that we can arrive at no very exact result, in consequence of their mutual connexions and overlappings: but nevertheless it will be found in general, that on the surface of a vertical section, somewhere about sixty intervene between any two corresponding points on the opposite surfaces of the tissue.

There is a fact of some interest to be learnt from such a section, if it be made extremely thin, and it is this:—that the connexions between the horizontally-extended lamellæ of the cornea are themselves membranous or lamelliform, and not mere fibres; for on opening out the lamellæ, so as to enlarge their interspaces, very delicate membranes are seen passing from one to another, and it is but rarely that complete perforations exist, however thin the sections have been made. In such specimens, viewed under a high power, we have a faintly fibrous texture apparent in even the *most delicate* of these films of membrane, the fibrous elements being held together in that form by an homogeneous intervening substance.

The nature of the *interstices* of the corneal tissue does not appear to have been particularly inquired into. It has been generally considered that the interlamellar spaces are themselves flattened or lamelliform, and that they contain fluid in sufficient quantity to fall easily from one part to another; and it has been imagined that inflammatory products, lymph, or pus, might gravitate in such natural spaces to the most dependent part of the cornea. For the existence of fluid, stress has been justly laid on the fact, that if we lay bare the corneal tissue and make strong pressure on the globe, we shall observe first a dewy moisture, and then distinct drops of transparent fluid over the entire surface. But this shows the porosity of the entire cornea, rather than the existence of free fluid in its interspaces; for in the perfectly fresh eye the dew does not form until the pressure has been kept up for some time, and under continued pressure the aqueous humor gradually passes out; while if this humor have been previously evacuated by puncture and replaced by air, no dew forms upon the surface. Moreover, an incision into the lamellated cornea does not set free any visible fluid.

It has been sometimes thought that pressure produces opacity of the cornea by driving out fluid from its interstices ; but the return of transparency is so simultaneous over the whole surface, when the pressure is remitted, as to forbid the supposition of any fluid having escaped and re-entered at the border, while the presence or absence of the aqueous humor does not affect the result at all : pressure produces opacity if the chambers are filled with air. Hence it may be concluded that the fluid existing in the corneal tissue is only sufficient to moisten its elements, not enough to lie free in its interstices : and, further, that the elementary lamellæ are naturally in contact with one another, much in the same way that the filaments of the areolar tissue touch one another in other parts.

Of the Corneal tubes.

Being desirous some years ago to discover whether the interstices of the cornea proper had any regular shape or arrangement, I made a small puncture near the border of the cornea of an Ox, and, introducing the mouth of a mercurial injecting tube, was delighted to find the metal, under gentle pressure, running in a beautiful and curious manner, quite unlike anything that occurs in any other tissue, and from its constancy and peculiar figure evidently demonstrative of a natural structure. The mercury coursed rapidly along in perfectly parallel and very delicate lines for a short distance, then diverged at an angle into other similar tubes, which were found to cross the former either above or below. The tubular spaces thus injected appeared to be jointed or broken at varying intervals, and to present what in the nerve-tubes would be termed a varicose condition. The whole lamellated cornea was filled with such tubes, for at whatever depth or part the mercury was inserted, the same results followed ; although,

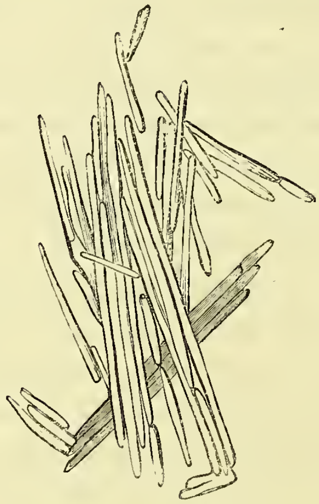
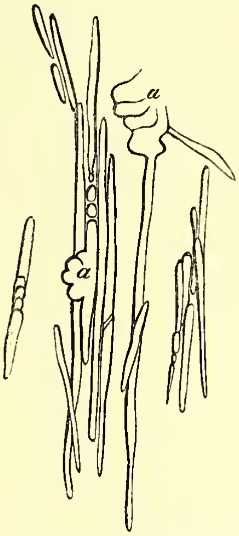


FIG. 2.—TUBES OF THE CORNEA OF THE OX, INJECTED WITH MERCURY.

from the unnatural distension occasioned by even a small extent of such injection, it was impossible in a single specimen to fill the interstices of every portion of it, and at different depths, at one and the same time. These definitely marked passages in the corneal tissue it seemed not very easy to force or burst; but when the mercury was urged to that extent, it separated the horizontal lamellæ for a greater or less space, and formed irregular flat patches, very similar in shape to those which are met with in the morbid state known as *onyx*, and which latter, I therefore conclude, is attended with a breaking down of the membranous connexions between the horizontal lamellæ —connexions which form the side walls of the corneal tubes now described.

I found that I could inject the tubes with size and vermilion quite as definitely, though not so easily, or so as to form so beautiful an object, as with mercury; but this fact was sufficient to prove that the peculiar varicosities of the tubes were not a false appearance due to the tendency which mercury has to collect itself into the globular form.



At *a a* extravasation has occurred.

FIG. 3.—TUBES OF THE HUMAN CORNEA, INJECTED WITH MERCURY.

What I have now mentioned is what occurred with the cornea of a large quadruped. I found it far more difficult to make a similar injection of the human cornea, or of that of the Cat or smaller animals, and it is not probable that interstices of equal size—perhaps hardly of the same shape and arrangement—exist in the latter specimens. From the greater thinness of the membrane, and the greater proximity of the entire tissue to the vascular arches from which its nutrient supply is drawn, it may be supposed that such a free and ample system of canals may be dispensed with. In the human cornea, however (as in fig. 3), I have clearly seen a tubular arrangement of the interstices under favourable circumstances: although, in general, the tissue too readily gives way under the distending force which it is requisite to employ. The length of the canals between the constrictions does not exceed the twelfth of an inch, and is for the most part much less, while their width is from $\frac{1}{500}$th to $\frac{1}{600}$th of an inch: this is in the human cornea.

It might be conceived that these corneal tubes were a modified form of lymphatic vessels, as it is generally thought that a close lymphatic network may be injected in a somewhat similar fashion under the skin and other parts. But I have not found the mercury escaping along the lymphatic trunks when pushed from the cornea towards the sclerotica. On the contrary, it requires hard pressure to make it escape from the cornea at all, and then it enters the anterior chamber of the eye, or the space between the sclerotica and choroid, or even subconjunctival bloodvessels. Hence it is probable that the corneal tubes do not communicate *directly* with any other set of vessels or natural channels.

With regard to the use of these corneal tubes, we shall probably not be far wrong in supposing that they serve to promote and facilitate the permeation of this thick non-vascular structure by those fluid portions of the blood which alone have access to it. Whether the special arrangement of the tubes which I have described is concerned in endowing the cornea with its necessary transparancy, it does not seem possible to determine. It might be imagined to contribute to hold all the lamellæ in place, and to prevent derangement of their relative position. A brief account of these, and other points which I shall notice, is given in the third part of the 'Physiological Anatomy and Physiology of Man,' just published by Dr. Todd and myself.

Junction of the Sclerotica and Cornea.

I have already stated that the lamellated tissue of the cornea is the only one which, properly speaking, is continuous with the sclerotica. This continuity is so perfect that the two textures cannot be torn asunder, or in any way be shown capable of detachment along the line of junction. Even maceration is not capable of effecting their separation; and if we consider the close affinities of the two structures, and their mode of union, it will be easy to understand the reason of this. In fact, both belong to the class of fibrous tissues, and have very similar physical and chemical properties. The fibrous bundles of the sclerotica, intricately interlaced and intermixed with threads of yellow elastic tissue, become continuous at the border with the laminæ of the cornea. The elementary parts of the one join on to those of the other; the interstices, which are irregular and open on all sides in the sclerotica, assume a regular arrangement, and become tubular in the cornea. On the surface of a very thin vertical section of the two structures, carried through their line of junction, the transition of one into the other can be very satisfactorily traced. By acetic acid the sclerotica swells and becomes transparent, and exhibits the yellow fibrous element of its structure, and also sparing nuclei, like those belonging to tendinous parts. By the same agent, the cornea first grows opaque as the arrangement of its parts is interfered with by the swelling of the tissue during the progress of the acid through it, but subsequently it all very nearly resumes its transparency, merely displaying here and there on the surface of its lamellæ the elongated nuclei which were previously indistinctly seen, and which correspond closely with those of the sclerotica and other fibrous tissues.

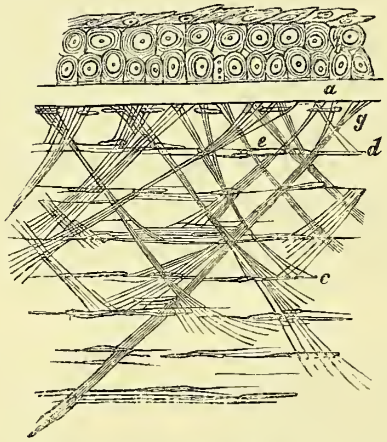
The description of the lamellated cornea will be most conveniently concluded in connexion with that of the *anterior elastic lamina;* to which I shall, therefore, now direct your attention.

The *anterior elastic lamina* has not hitherto, as far as I know, been distinguished by anatomists, and yet it seems a structure of a very interesting kind, an acquaintance with which will perhaps enable us to descriminate some morbid phenomena from others with which they have been classed. It is a continuous sheet of homogeneous membrane, nearly similar in essential characters to the posterior elastic lamina of the cornea and the capsule of the lens, being perfectly transparent and glassy, without appearance of internal structure, and being very slightly or not at all influenced by acids. Its thickness in the human eye is from about $\frac{1}{1200}$th to $\frac{1}{2000}$th of an inch, and it forms an unbroken covering to the whole laminated cornea, giving it that smooth glistening surface which is exposed by scraping off the conjunctival epithelium. This latter rests upon it as the epithelium does upon the basement membrane in other situations; and I may observe that it appears to me to be strictly a highly-developed form of the basement membrane of the mucous system, remarkably modified in this particular part to answer a special purpose.

The manner in which the anterior elastic lamina is united to the lamellæ which it serves to cover, is very interesting. It must be borne in mind that the anterior surface of the cornea is convex, and that the maintenance of its exact curvature is of primary importance to vision, as it is there that the first inflection of the rays of light falling on the eye takes place; and further, that the conjunctival epithelium being a soft and fragile substance must take the figure of the surface on which it rests: hence, probably, the arrangement I am about to mention. The anterior elastic lamina, a firm, resisting, uniform layer, placed in front of the more soft and porous lamellated tissue is tied down to the anterior lamellæ, at innumerable points, by filaments of similar texture to itself, which it sends in among them. These, as they penetrate the lamellæ, divide and expand in such a manner as to take firm hold of them, and are thus gradually spent among the four or five lamellæ which lie nearest to the surface. It is singular, too, that these filaments are not set vertically, but everywhere in a slanting direction among the lamellæ, so that in a vertical section they appear to cross one another at right angles. This arrangement might, I imagine, be shown, on mechanical principles, to be the best possible for the maintenance of the convexity of the front of the cornea.

It is obvious, from the elaborate manner in which the anterior elastic lamina is thus tied down to the lamellated texture, that it can hardly be raised as a separate layer; and hence, probably, the reason of its having been hitherto overlooked. In fact, it scarcely admits of being demonstrated, except on the face of a section of the cornea.

The anterior elastic lamina becomes exceedingly thin, and disappears, at the margin of the cornea, its attenuation being accompanied by an increase in the number and size of the filaments which it sends down to the lamellated tissue; so that it seems to expend itself by giving origin to these filaments. And from this extreme border, where it ceases to be distinguishable, a great abundance of them runs into the sclerotica, in that slanting course which the elastic lamina would have itself taken, if it had been prolonged in the direction of its own curvature. These filaments mingle with the elements of the sclerotica, and are gradually lost among its middle fibres. The artificial mode in which the margin of the anterior elastic lamina is thus fixed, may be roughly likened to that of the awning of a tent. It is rendered much more obvious if a thin vertical section of the parts at the junction of the sclerotica and cornea be treated with acetic acid.



a, Anterior elastic lamina. *b*, Conjunctival epithelium. *c*, Lamellated tissue. *d*, Intervals between the lamellæ, showing the position of the corneal tubes collapsed. *e*, One of the nuclei of the lamellated tissue. *g*. Fibrous cordage sent down from the anterior elastic lamina.

FIG. 4.—VERTICAL SECTION OF THE HUMAN CORNEA NEAR THE SURFACE. MAGNIFIED 300 DIAMETERS.

That this lamina, although apparently homogeneous, like a sheet of glass, is very permeable to fluids, as is the capsule of the lens, may be readily shown by squeezing an eye after the conjunctival epithelium has been scraped off: the small drops which collect on the surface rest upon this lamina after having transuded through it.

The existence of this lamina will help, I think, to explain, what must have often puzzled surgeons, viz., the tenacity with which small particles of steel, or other sharp angular fragments, stick in the front of the cornea only just within the surface. These will often remain for many days, or even weeks, and prove the cause of much inflammation, and yet still be found difficult of extraction; which could hardly be the case if the lamellated tissue and the conjunctival epithelium were the only textures in which such particles could be imbedded.

The *conjunctival epithelium* of the cornea may be now conveniently adverted to: it is that delicate, soft, almost pulpy layer, which forms the anterior surface of the cornea, and is so easily raised by the knife or needle. It is a continuation of the epithelium of the conjunctiva covering the front of the sclerotica and lining the lids, and consequently of the cuticular investment of the body.

In those animals which lose and renew the cuticle, by a constant process, unmarked by periods of intermission, the superficial particles are gradually shed after arriving at their mature state, while others are as gradually originated in the deepest region, on the tissue which serves as a basis of support, and near which lies the source of their nutriment. This is precisely what occurs on the outer surface of the cornea in the human eye. The epithelial particles are exceedingly transparent, but in position, form, and mode of growth and decay, they bear a close resemblance to the epidermis. In different animals the number of epithelial layers varies according to the size of the eye: in man, they constitute only a triple or quadruple series, altogether not exceeding the $\frac{1}{500}$th of an inch in thickness. The deepest, which rest on the anterior elastic lamina as on a basement membrane, are slightly elongated vertically, and stand endwise; the next are angular or subglobular in shape, and the most superficial are flattened scales, more or less overlapping one another, and of a darker hue than the others when seen by transmitted light. The imbricated scales of the surface have their minute inequalities filled up in the natural state by the watery secretion of the lacrymal gland, so as to present a nearly smooth refracting surface to the impinging rays of light; and by the frequent movements of the eyelids, the particles which are decaying and losing their place are brushed away, and escape by the nose. In a learned and interesting paper by Dr. MACKENZIE,* you will find described a method of seeing in your own person the nature of the corneal surface. This epithelium is rapidly renewed, if scraped off.†

We may now, gentlemen, turn our attention to the *posterior elastic lamina of the cornea*, a layer which has been long known as the membrane of Demours or of Decemet, or as the elastic lamina of the cornea, or as the corneal part of the membrane of the aqueous humor.

This layer is very easily detached by scraping from the hinder surface of the lamellated tissue of the cornea, for it adheres but slightly to this tissue, and sends no filaments among the lamellæ, as the anterior elastic lamina does. It is a uniform, transparent, homogeneous layer, considerably thinner than the anterior elastic lamina (being only from $\frac{1}{2000}$th to $\frac{1}{3000}$th inch thick), but, like it, not affected by maceration, by boiling, or by the action of acids. Though very hard, and capable of resisting much pressure, and giving a crisp sound when divided by the scissors, yet it is very brittle and easily torn, and its fragments then show a remarkable tendency to curl up on all sides into rolls, and always with the anterior or naturally convex and attached surface inwards in the roll, so that it would appear to be formed or laid down *in situ* in a curve precisely the reverse of that which its elasticity inclines it to assume.

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* On the "Vision of Objects on and in the Eye," 'Edinb. Medical and Surgical Journal,' No. 164.

† Viz., in about three days. The instantaneousness with which the bloodvessels of the neighbouring conjunctiva, and even of the whole eye, dilate and become turgid with blood, when this epithelium is abraded, has often excited my astonishment. The share of the nervous system in this phenomenon is partly indicated by the severe and apparently inordinate pain which attends so slight an injury.

When an ulcer has destroyed the lamellated tissue, it sometimes happens that, for a short time, the posterior elastic lamina is thrown forwards into the breach, by the aqueous humor behind it, and forms there a small pellucid vesicle, which, however, almost always soon gives way by rupture, allowing the humor to escape, and the iris to fall forwards against the opening. This morbid state illustrates very well the properties of the layer now under consideration.*

With regard to the behaviour of this posterior lamina at the margin of the cornea, much difference of opinion—I might say, much uncertainty—prevails; some holding that it is reflected in a modified form over the whole of the anterior and posterior chambers of the eye, others believing it to terminate with the cornea; but none, as far as I am aware, having given a full and accurate account of its actual condition, which is one of considerable importance to a correct knowledge of the physiology of the organ, and to the understanding of some of its diseases.

Marginal Plexiform Tissue of this Lamina.

This layer, then, will be found to terminate at the border of the cornea in the form of plexiform fibres of the yellow elastic kind, or that variety which is allied to itself in essential characters. In this respect it resembles the *anterior* elastic lamina. The plexiform fibres spring only from its anterior surface, or that towards the lamellated cornea. They begin to appear a very short distance from its edge, and, as they arise, the lamina itself becomes thinner, and is at last altogether spent. They all pass irregularly outwards, occupying, of course, a position between the posterior elastic lamina and the lamellated cornea; and are finally reinforced by those fibres which come from the thin and extreme edge of the lamina. Immediately beyond this edge, therefore, at the rim of the anterior chamber, there is a layer of open plexiform fibres, passing outward, or from the axis of the eye, and being the continuation or representative of the posterior elastic lamina. The posterior of these fibres then curve backwards to the iris, and become inserted into its anterior surface at its greater circumference, in the form of small pillars; and near their insertion they begin to resemble the white fibrous rather than the yellow fibrous tissue in chemical and other qualities.

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* In a case recently under my care, the posterior elastic lamina saved the ulcer from perforating. Mr. James M——, æt. 52, had at the end of June a central ulcer, which was touched with lunar caustic, and he took quinine. By the middle of July it had gradually penetrated to the deepest layers of the cornea, and the posterior elastic lamina was laid bare, and bulged slightly into it from below, especially when trifling pressure was made upon the globe for the sake of testing the condition. Under a continuance of the tonic treatment this ulcer gradually filled up, the aqueous humor not having escaped; and I saw him in February following with an opacity on a level with the rest of the cornea, but with its central portion (answering to the previously exposed posterior elastic lamina) of a denser white than the border.

When this lamina is thus exposed at the bottom of an opaque milky ulcer, centrally placed, the dark pupil may become visible through it, and look like a particle of dirt, deceiving the surgeon into an attempt to remove it, in making which he inevitably opens the anterior chamber.

I have found these *pillars of the iris* much more evident in some animals than in others; but time will not allow me to enter on comparative details. They exist in all mammalia, and have their analogues in other classes. They are in contact with the aqueous humor, where they form the rim of the anterior chamber. A needle may be passed underneath them from the anterior chamber, so as to suspend by them a considerable fragment of the eyeball.

The great portion, however, of the fibrous continuation of the posterior elastic lamina goes not to the iris, but to the *ciliary circle*—a name by which anatomists refer to a flattish circle of grey semi-transparent tissue, which intervenes between the ciliary processes of the choroid and the sclerotica, immediately behind its junction with the cornea, about which extraordinary differences of opinion prevail, but which I shall hope to show you, in a subsequent lecture, is muscular. For convenience, therefore, I will now assume that it is such, and term it the *ciliary muscle*. This muscle arises, then, from the fibrous tissue coming from the posterior elastic lamina—the fibrous tissue passing in a sheet backwards to the anterior region of the ciliary processes, and giving origin on its outer surface, or that turned from the anterior chamber, to the fibres of the ciliary muscle, which then clothe the outer surface of the choroid for about one-eighth or one-tenth of an inch, as far as opposite to the *ora serrata.*

There are still other fibres derived from the posterior elastic lamina—viz., those placed most anteriorly, and which were the first to take origin from it. These, after a short course outwards, become separated from the sclerotica by a narrow space all round, known as the *sinus circularis iridis*, and which has been considered as a venous canal; afterwards they pass to be united firmly to the sclerotica beyond this sinus, and in so doing share principally in its formation. But there also exists here a series of *circular* fibres, those just described being more or less radiating: the circular lie outside the others, are opaque, white, and stiff, contributing to the formation of the circular sinus, and to that firm union, the *ciliary ligament*, which subsists between the ciliary processes and the anterior rim of the sclerotica; and which, as a whole, effectually serves to prevent the aqueous humor from escaping into the space between the sclerotica and choroid.

I am aware of the difficulty I must experience in attempting to give you a clear description of this structure, before I have passed in review those others with which it is associated. What I have now said, however, must suffice for the present, and I shall return to it in connexion with the iris and choroid and lens. A few words remain concerning the *posterior epithelium of the cornea*, or the *epithelium of the aqueous humor*.

This is so extremely delicate and so perishable a layer that it has only of late years been recognised, and yet it is very easily prepared for examination. It is a single series of flat epithelial nucleated particles, placed side by side, and united by their margins. Even in large animals the epithelial cells are not in a double layer. It is co-extensive with the posterior elastic lamina, which it separates from the aqueous humor. It would appear, however, from what has just been said concerning the conversion of the posterior elastic lamina at its border into fibrous tissue, which in part passes through the aqueous humor to the iris, that this epithelium must cease with the elastic lamina, since there is no longer any stratum on which it can rest. I have not been able to discover the smallest appearance of it upon the pillars of the iris, and I conceive, therefore, that it is limited to the cornea.

I have called this the epithelium of the aqueous humor, because it is the only true epithelium which can be found in contact with that fluid. I shall have to show in a future lecture that the front of the iris has no true epithelial investment, and that the front of the lens is also destitute of such a covering. It seems, therefore, incorrect to speak of the chambers of the eye as lined by a serous membrane, or of the aqueous humor as contained within a proper capsule; and I suppose that practitioners must abandon the *name*, at least, of that affection, which is now generally termed *aquo-capsulitis*, even if they continue to regard it as a distinct disease.

In my next lecture I shall proceed to notice some of the morbid states of the sclerotica and cornea; and shall endeavour to connect my remarks as far as I can with the anatomical, and, I fear, rather dry details, which I have had to dwell upon to-day.

LECTURE II.

Bloodvessels and nerves of the sclerotica and cornea—character of the nutritive process in these structures.—Morbid states of the sclerotica and cornea.—Sloughing of both corneæ from defective nutrition.—Reparative process in the cornea.—Anatomy of a simple ulcer of the cornea.—Formation of vessels in the cornea.—Effect of general disease on the cornea.—Lymph or pus in the lamellated tissue.—Pustules.—Opacities of the cornea.—Development of papillæ on the cornea.—Anatomy of Staphyloma corneæ.

Gentlemen,—In my last lecture I reviewed the structure of the outer tunic of the eyeball, consisting of the sclerotica and cornea, and described the several layers of which the latter is composed. It remains for me, before proceeding to the more internal parts, to make some observations on the nature of the process of nutrition, as it obtains in these structures, and on the bearing of their anatomical construction on the nature and progress of some of their more important diseases.

Both the sclerotica and the cornea are sparingly supplied with the materials of nutrition, as a glance at the arrangement of the bloodvessels will show. The sclerotica is obliquely pierced behind with numerous arteries derived from the ophthalmic, termed the *posterior ciliary;* but these go almost exclusively to the choroid, only giving a few minute twigs to the sclerotica as they pass. In front, too, the arteries which have supplied the muscles of the eyeball send forwards beyond the tendons small prolongations, which are visible under the conjunctiva, and lose themselves in the sclerotica, within an eighth of an inch from the margin of the cornea. These, however, traverse rather than supply the sclerotica, and anastomose with vessels of the ciliary muscle and iris. Hence, in the most successful injections, the sclerotica itself is with difficulty tinted by the artificial colour, and the microscopic inspection of parts so prepared exhibits only a few slender capillaries coursing among the greatly preponderating mass of the white fibrous tissue. And if we pass from the sclerotica to the cornea, we shall find the most unequivocal proof that no bloodvessels at all encroach far beyond its border. The evidence which injections are capable of affording on this head is very decisive. We now know that the capillaries are, in almost every organ, definite and determinate tissues, having proper walls, which may be distinguished from the parts among which they lie; that they have a certain limit as regards minuteness, and that they form everywhere a closed system of tubes, porous, indeed, so as to be capable of transmitting fluid materials, both inwards and outwards, by a process of imbibition, but nevertheless having walls of unbroken membrane, without breach or orifice. Hence if an injected specimen exhibits a system of such canals, replete with artificial coloured contents—its ramifications regular, having margins formed by rounded, arched, entire capillaries—we may safely assert that the vascular network really terminates naturally at those margins, and that the tissue beyond has been as impermeable to the red particles of the circulating blood, as we find it to be to our prepared fluids. This is precisely what occurs in the case of the cornea. The vessels of the sclerotica, and of the conjunctiva covering the sclerotica, send numerous twigs towards the cornea; but all, on arriving within the corneal tissue, turn back, forming numerous arches, which run parallel to the margin of the cornea for some way, and then return from whence they came. Thus we have a striking difference between the sclerotica and cornea in addition to those before insisted on,—that the one is permeated by bloodvessels, the other is entirely devoid of them.

I may say a few words here on the *nervous supply of the two structures.* No doubt the nerves of both are few; the sclerotica gives passage to the ciliary nerves, and although they have not been demonstrated, it is possible that it receives some filaments from them. In a state of health it seems to be very insensible, but when inflamed, like many other dull and almost insensible parts, it appears to be capable of becoming the seat of very acute pain. In the cornea, nerves derived from the ciliary are said to have been discovered by more than one anatomist of trust: I cannot say that I have myself seen them, although I cannot doubt their existence; for when we remember that nerves in their peripheral distribution may lose their tubular nature and their characteristic microscopic appearance thence derived (and I have constantly found the ciliary nerves do this), we may well be content to receive *pain* as sufficient evidence that a part is not destitute of nerves. That the cornea has a degree of sensibility capable under some forms of irritation of being exalted to a considerable height, is matter of common experience.

From what has been said, it may be safely concluded that the sclerotica and cornea are slowly renewed in their elementary constitution by the process of nutrition. No doubt the presence in or near them of the materials of change is absolutely necessary for the continuance of their life; but what I would endeavour to impress upon your minds is this: that their structure is feebly supplied with blood, or the nutrient part of that fluid, that the process of nutrition in them is therefore slow, inactive, and easily impaired, either by impoverishment of the nutrient material or by any mechanical interference with its due and regular supply. These observations apply more to the cornea than to the sclerotica, because the latter has vessels, the former has none; the latter, therefore, is supplied interstitially, as it were, with the power of life, growth, and nutrition; the latter must derive through the medium of its circumferential parts whatever is requisite to sustain the integrity of its more central portions.

Morbid States of the Sclerotica.

I shall have but few observations to make, gentlemen, on the morbid states of the sclerotica, in their special relation to its structure: wounds of this part readily heal by the adhesive process, the cicatrix being semi-transparent as in tendon; and minute punctures are generally harmless, even when they penetrate not only this coat, but the choroid. It is possible that the readiness with which lacerations and incisions of the sclerotica heal, is ascribable to the thinness of the tissue, and to the fact that it has on both its surfaces an abundant supply of blood in the contiguous textures. The experience which surgeons have acquired in their operations on cataractous eyes, affords ample proof of the slight tendency which simple wounds of the sclerotica have to take on an unhealthy action. The form of inflammation which the sclerotica usually undergoes is the rheumatic. Into the nature and symptoms of this it would be out of place to enter, as we must limit ourselves at present to the anatomical condition.

In inflammation of the sclerotica, when least complicated with conjunctival disease, its vessels are seen to be unnaturally filled with blood; its capillaries are distended, so as to become visible by imparting a tint to the fibrous tissue, and the minute arteries and veins enlarge and become tortuous. All these are distinguished by their purplish hue, compared with the more superficial vessels of the conjunctiva under inflammation.*

In some delicate persons the sclerotica is so thin in its anterior part as to derive a bluish tint from the choroid underneath. This is no disease, but in cases of old-standing choroidal or other disease within the globe, which has operated so as to cause a slow and gradual distension of the outer coat, the pigment is in like manner disclosed under the bulging and attenuated sclerotica; and I have observed in some cases that under this internal stretching force the sclerotica is apt to yield in lines passing backwards from the cornea, so as to form slits or chinks more or less radiating, through which the choroid is more obviously seen. This depends on the disposition of the fibres of the sclerotica, which I alluded to in the last lecture, viz., their passing at the anterior region rather in a radiating direction from the cornea than in any other arrangement.

Morbid States of the Cornea.

To the surgeon, as to the anatomists, the cornea is a much more interesting and important texture than the sclerotica, and I therefore propose to be a little less brief in commenting on some of its principal morbid states, especially such as either illustrate, or are illustrated by its structure, as explained in the former lecture.

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* For a rare example of ulcers of the sclerotica, *see* Case A in the Appendix.

And first, gentlemen, in evidence of the comparative feebleness of the process of nutrition in this texture, I shall relate the following case which occurred at this hospital during the present spring.

Sloughing of both Corneæ from Defective Nutrition.

On the 8th March, a mother, herself reduced in strength and looking ill, brought her infant, 13 months old, to the hospital, on account of its eyes. I found that both corneæ were in a state of slough, flaccid, of a pale yellow, like macerated leather; that this slough comprised the whole area, except a very narrow belt of about $\frac{1}{20}$th of an inch nearest to the sclerotica, from which latter a few minute vessels were shooting towards the line of separation, which was already beginning to be established between the dead and the living parts. The conjunctiva exhibited very little vascularity, and had evidently not been suffering from inflammation. The infant was pallid and puny, with a pinched and anxious countenance. I found that the mother had been suckling the child till seven weeks from the time I speak of, being herself ill and weak, and very insufficiently nourished; that on going into the workhouse they had been parted, and that she first noticed the eyes to look "weak" three weeks since. The bowels had been constantly purged for eight days; and she had been taking rhubarb and magnesia. The compound powder of chalk, with opium, was given every four hours, with the Liq. Cinch. of Battley, and beef-tea, with small quantities of brandy, and Mr. Heward kindly undertook to visit her at her own home. On the 11th (three days afterwards), I found more vascularity at the margin of the corneæ, and over the white of the eye, but with hardly any secretion. The bowels had been less relaxed, but the stools were still green and loose. She had taken some wine and bark, but would not touch the beef-tea. She was evidently weaker, and moaned constantly. In two days afterwards she died.

In this instance we find the cornea falling into a state of gangrene from defective nutrition; the impoverishment of the blood, manifested in various degrees in the other textures of the body, here leading to the complete destruction of a tissue which naturally has a very small supply of that necessary fluid, and which therefore is but too ready to yield its vitality when that supply is withheld. The case of this poor child finds a parallel in others which have been related, as occurring from actual starvation, or the privation of all sustenance, and perhaps still more aptly in those animals which Magendie confined to a diet of sugar and water, or other non-azotised food, and of which one of the more constant evidences of declining power was the sloughing of the corneæ, and the consequent destruction of the eyeballs.*

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* The corneæ may fall into slough in an analogous way after scarlatina. *See* Appendix, Cases B.

I may also mention the case of a woman who is now in attendance here, and who, on her first appearance some months ago, had a dull, hazy state of both corneæ; the surface having lost its brilliancy, and the whole texture being very uniformly obscured. The approach of this condition had been very gradual. It had been attended with no redness, nor was there, at that time, any excitement of the circulation in the neighbouring sclerotica or conjunctiva, or any development of new vessels in the cornea itself. She was pallid, but her muscular strength was not remarkably reduced, nor could I discover that she had been insufficiently fed in regard either to quantity or quality, or that she had any disease affecting a vital organ. Nevertheless, her pulse and countenance bespoke a system in which the powers of life, from some cause or other, were considerably depressed, and Mr. Dixon concurred with me in recommending a strictly tonic course of treatment, comprising steel and quinine, with such modifications in diet, place of abode, and mode of life, as her situation appeared to render desirable. Under this plan, which has been continued up to the present time, a steady improvement has taken place in the condition of the corneæ. The haze is clearing away in the most gradual manner, and without any unnatural vascularity of the part or neighbourhood, and her looks are much improved in every respect. I cannot help regarding this affection as simply the result of an impairment of the nutritive process in the whole body, showing itself in a special manner in this texture of feeble power.*

Reparative Process in the Cornea.

The cornea when healthy is readily repaired after injury; punctures and incisions being followed in general by speedy reunion of the divided parts, without suppuration or sloughing. The adhesive process is here presented to us in its simplest form, for it takes place in a structure which contains no bloodvessels, and therefore where none have been divided. But if we bear in mind that all tissues have a proper life of their own, of which their several properties and actions are the necessary manifestations, and that the bloodvessels are but ministerial to the proper life of the tissues they supply, by serving as the medium through which the materials essential to life are brought within their reach, and what is rejected by them is carried away, we shall readily understand how it is that a tissue which, like the cornea, originally grew, and has its ordinary life sustained without the presence of interstitial vessels, may be also repaired and renewed without them within certain limits. For the reparative actions, in their natural form, are nothing more than those of growth and nutrition, modified by the new conditions occasioned by external accident, and tending constantly to a removal of those new conditions, and the restoration of the normal state.

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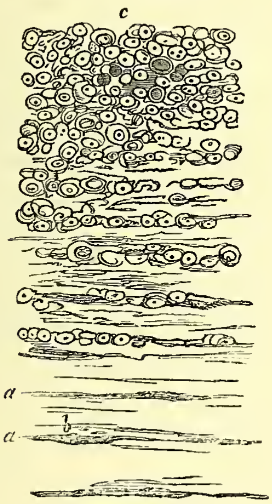
* This patient, at the end of three months, had recovered the transparency of the corneæ, and was much improved in health. She has, however, on two subsequent occasions, had relapses, from the last of which she is now recovering, but with the right cornea considerably, and I fear permanently, clouded.

If we puncture or incise the cornea, the first effect is a change wrought in the natural actions of nutrition then existing in the wounded part—a change which can only be described as a mechanical interruption to those actions, and which, from the resultant train of pheuomena, has been often called a stimulus. This is speedily followed by the presence of an increased quantity of blood in the vessels that are nearest to the wounded part, viz., in those of the conjunctiva and those of the sclerotica; and thus the materials from which the breach is to be made good are brought in greater abundance to the part that requires them. We cannot doubt that as these vessels, comparatively so remote, are thus affected, so the part of the corneal tissue intervening between them, and the exact seat of injury, is pervaded by a corresponding change, of which the general expression is this—that it is one of exalted nutritive vigour; the play of forces, and the interchange of material, which mark the nutritive function, being more energetic and more rapid than before. And whatever phenomena of this kind occur in the intermediate tissue are concentrated in an especial manner about the wound itself. In a short time, even in the course of a few hours, as I have ascertained in the case of the lower animals, the vicinity of the injured part begins to contain in abundance those minute particles, nuclei, or cytoblasts, as they are called, which exist naturally, though sparingly, in the corneal lamellæ, and the relative quantity of which may be regarded in most tissues as an index of the intensity of the nutritive function. These particles, I say, hastily, indeed, and imperfectly formed, are speedily found choking the interstices of the tissues in the lips of the wound, and covering its surface, so as to occupy whatever space was left between its opposite sides, and bringing them into temporary union. From the presence of these embryo materials of new tissue, intermingled among the elements of the old, is derived that slight milky opacity which envelops and marks the seat of wound, and which, if the injury be extensive, may engage a considerable extent of the cornea in the direction of the neighbouring bloodvessels. The subsequent changes I need not particularly dwell upon. The breach being filled, the new material is gradually transformed into products resembling those tissues among which it has been poured; the bloodvessels, at the border of the cornea, resume their size, and at length, in the most favourable instances, all vestige of the wonderful process which has taken place vanishes away.

Such is the progress of the actions which usually ensue when the surgeon punctures the cornea with his needle for the purpose of operating on a cataract; and the same takes place, in general, whenever there is no destruction of substance, where the wound is not too large, and where its margins have been accurately adapted. But it will readily be conceived that, in cases of wounds with loss of substance, or attended with extensive division of parts, the demands on a tissue so feebly nourished must exceed its limited powers. The result will then oftentimes be the failure of the adhesive process, with the establishment of a temporary ulcer or open breach, or with an actual sloughing of the lips of the wound. The reparative actions then advance more slowly, and in a modified form, by a species of granulation very similar to that which obtains in corresponding states of the skin or mucous membrane.

I had an opportunity last year of examining a small ulcer which had been occasioned on the centre of the cornea of a Cat, by the contact of a small piece of caustic potass, three days previously. The conjunctival epithelium and the anterior elastic lamina had been removed, and the superficial lamellæ of the cornea proper formed the bed of the ulcer. These were softened and semi-opaque, from the presence of great numbers of the nuclei already alluded to, in and around; and it was interesting to observe that their numbers were greatest on the surface of the ulcer, and diminished in proportion to their distance from it. In the section of the ulcer, represented in fig. 5, the nuclei are seen occupying chiefly the position of the corneal tubes, especially in the deeper part. (Compare this with *d*, fig. 4.) We have, in this example, perhaps the simplest condition of an ulcer that can occur in any texture, and it is therefore well deserving your attention.

Free surface.



a, *a*, Indicate the position of the corneal tubes in the sound tissue below the bed of the ulcer. *b*, Nucleus of the lamellated tissue. The surface of the ulcer is seen formed by a crowd of vesicular nuclei, most of them with a nucleolus. These were in various stages, and mingled with finely granular matter.

FIG. 5.—VERTICAL SECTION OF A MINUTE ULCER ON THE SURFACE OF THE CORNEA OF A CAT, THREE DAYS AFTER THE APPLICATION OF CAUSTIC POTASS. MAGNIFIED 300 DIAMETERS.

Development of Vessels in the Cornea.

Few things are more interesting in the history of reparative processes in the cornea, than the fact which we observe every day, of its capacity of becoming furnished with bloodvessels derived from those of the conjunctiva and sclerotica. If any irritation is long kept up, or if any ulcer exists having to heal by a slow and gradual process, we usually find in the interval between it and the neighbouring vessels, a grayish, half-transparent tract, distinguishable from the healthy cornea; and in this there are soon developed a series of vessels which presently declare themselves as arteries, capillaries, and veins, carrying the blood in a circuit through and about the seat of reparative action.* It is obvious that these are produced out of new matter, laid down before their actual formation in the line which they are to occupy. As a punctured wound is made good by the simple transformation of the new matter into the natural tissue, without the formation of new vessels, so, when time allows, and the extent of repair requires it, a portion of the new material is developed into vessels, which may serve the temporary purpose of expediting and fortifying the reparative actions, by bringing to them an immediate and interstitial supply of blood. Thus is the cornea made dull and useless for a time, by the introduction of a structure destructive of its transparency, in order that its integrity may be restored according to the natural laws of growth. When its restoration is somewhat advanced, and less blood is required, these new vessels dwindle; their coats, which are at best imperfectly organized, soon disappear, and the cornea becomes once more permeable to light. I have a specimen in which these adventitious vessels are displayed injected with artificial colour. They pass into the cornea from the conjunctiva, and from the whole thickness of the sclerotica, and occupy, in this particular instance, almost the whole thickness of the lamellated tissue.

The cornea may further become vascular without ulcer or wound, and simply as a result of continued inflammatory action, and this in two principal ways: either the new vessels may form a network on the front of the cornea, anastomosing on all sides with those of the conjunctiva, and only obscuring the lustre of its surface; or they may pass in very close and more parallel series from the sclerotica, so as to make the cornea uniformly of a dull red. The former state is the result of long-continued irritation of the conjunctival epithelium by granular lids or displaced lashes, and the vessels in all probability lie immediately beneath the anterior elastic lamina, in the more superficial lamellæ of the cornea proper; but I have never had an opportunity of actually ascertaining this. They can hardly lie over this lamina, and it is too thin to contain them in its substance. The latter condition results from chronic inflammation of the lamellated tissue, and is attended with an opaque deposition of new matter. The vessels run in among the lamellæ, and may occupy the entire thickness of the cornea proper, rendering it nearly impervious to light.

In both the forms of morbid vascularity now mentioned, the vessels are to be regarded as originally a result of diseased action, not as themselves the disease. They are developed under the salutary or conservative law of the organism, to enable a part of feeble vitality to sustain a morbid action to which it has become subject, and under

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[*] This does not always happen, for some chronic ulcers of the cornea will heal in the most gradual manner without the formation of any vessels in their vicinity, as *e.g.*, in Case C, in the Appendix.

which its vitality would otherwise sink. It is true that their presence marks the existence of disease, and is to a certain degree an index of its extent, but we must be on our guard against imagining that it constitutes its essence. Unless these vessels had been developed, the diseased process would long ago have terminated by the total destruction of the tissue. If, in the case of the impoverished infant which I related just now, there had been sufficient vigour in the nutritive and organizing process to fill the corneal tissue with offshoots from the surrounding vessels, the eyes might not have perished.

The cornea, and other parts of low vitality, or of such a texture as cannot speedily develop new vessels, often fall into gangrene under any sudden inflammation, because their vascular supply is either very limited, or cannot expand in correspondence with the demands of the morbid action.* On the other hand, practical surgeons know that it is very difficult to induce destructive inflammation in erectile tumors, which are distinguished by the abundance of their vascular supply.

We may even go further, and maintain that these adventitious vessels are necessary to a cure, and to their own removal, which may seem a paradox, but is nevertheless a very sustainable proposition. For as the morbid products (including the vessels) laid down in the cornea, require for their existence a certain accession of new material, in the way of continuous nutrition, so they cannot be removed unless means are found for the absorption and removal of the old material of which they are composed, and these means are mainly the vascular channels. As long as the material capable of being removed remains, the vessels remain also, though gradually atrophied, and ready to disappear; and sometimes, when the morbid products have been so long laid down as to have become organized into permanent forms of morbid and opaque tissue, the vessels, in reduced number, are found to remain also, as being necessary for the existence of that which cannot now be taken away by any interstitial process of absorption, and which must therefore be either nourished or die.

The presence of these vessels in parts of the cornea that have been once inflamed is often made evident by their sudden engorgement with blood, under any casual irritation, such as exposure to a strong light, or the puncture made by the surgeon's needle.

The unity which reigns throughout an organized body of so much complexity as our own, renders every part liable to be influenced by the state of the great organs, subservient to nutrition ; the digestive which provide, the respiratory which renovate, the circulating which distribute, and the excretory which purify the blood. The nutrition of every organ or tissue is subject to derangement, when the blood from which it derives its materials of renewal is impoverished or altered in quality, or when that healthy balance of the circulation is lost, to which Dr. Farre called your attention a short time ago.

It is not to be thought, therefore, that the morbid phenomena of any of the textures of the eye, or of the body at large, can be rightly comprehended by one who never has regard to the condition of what is termed "the *general health*," and, least of all, those of a texture like the cornea, which, being itself bloodless, and deriving its supply of nutriment by a frail tenure from surrounding parts, must necessarily be obnoxious in a peculiar degree to certain of those disturbances which another more favoured part might have sufficient vigour of life to disregard or overcome. It would be very easy to enlarge on so fertile a theme; but I must dismiss it with this simple allusion, or it would lead us too far from the proper subject of these lectures. It is perhaps of even greater importance still that these views should influence our minds in considering the propriety of an operation for cataract in any particular case, and especially of that of extraction, which involves an extensive division of the corneal tissue, and to the success of which, reparation of the wound by the first intention so much contributes.

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* Appendix, Case D.

Lymph or Pus in the Lamellated Tissue.

As a result of inflammation of the lamellated tissue, lymph or pus may be formed in the interstices of the lamellæ, attended, in the first instance, with irregular haze, and then with mottled or patchy opacity, as it accumulates in greater abundance in certain situations. If the inflammation be of an acute kind, and the effusion rapid, so as to gorge and distend and press upon the lamellæ too much before their supply of blood can be suitably augmented by newly-organized vessels, and especially if the system be at the same time in an enfeebled state from defective nourishment, or the scrofulous diathesis—the lamellæ become irregularly separated from one another, their tissue is broken up and destroyed, and a slough results which is usually of a flattish form, often engaging a considerable area of the cornea, but not its entire thickness, *i.e.*, following the direction of the lamellæ; or a simple abscess may form, which may discharge itself either backwards into the aqueous chambers, or on the external surface of the cornea. In either case it very commonly happens that the remaining part of the thickness of the cornea gives way, making a complete perforation, through which the aqueous humor escapes, and the iris prolapses. The injury done to the eye by such extensive disease is severe and permanent; a portion of the cornea has its place supplied by new matter, which becomes developed into an opaque tissue very different in constitution and elementary arrangement from that which has been removed, and the pupil is more or less distorted or dragged away from the axis of vision.

If, however, the inflammation of the lamellated tissue be less acute, and less disposed to run rapidly to destructive results, the lymph which is poured out collects in small portions among the lamellæ, giving an irregularly mottled aspect to the cornea, because some parts retain more of their transparency than the rest, though all are dim; and vessels are gradually formed in the corneal tissue, entering it at various depths from the neighbouring sclerotica. When this occurs, the sclerotica itself, for a short distance from the cornea, appears of a dull red, owing to the augmented quantity of blood passing through its vessels to supply this new demand. If the disposition to the formation of lymph in the corneal tissue continues, the enlargement of its vascular supply tends to accelerate the subsequent changes, the whole tissue gets interfused with opaque matter and additional vessels, and the original lamellated structure becomes thickened, softened, and obscured.

After so delicate and important a part has been apparently spoiled by a serious disease, it is not a little interesting to notice how completely and how speedily in many instances its perfect transparency may be restored by timely and judicious treatment. For in such cases you will observe that the original tissue of the cornea is not in any measure destroyed, or its arrangement permanently altered, unless the duration of the morbid state have been considerable, and time have been thus afforded for the organization of permanent forms of unnatural tissue in its interstices.

Moreover, when once the inflammatory action and the inclination to the formation of morbid products have been subdued, the bloodvessels which pervade the deteriorated structure begin to assist largely in its restoration, by expediting the absorption and removal of the newly-deposited lymph; and in proportion as this clearance is effected the vessels themselves diminish in size, and finally disappear. The speed and completeness with which the cornea resumes its previous state will depend much on the promptness with which the treatment is undertaken, and on the energy of the nutritive function in the part and in the whole body. In scrofulous subjects, who are especially prone to this affection, it is notorious that there exists in the constitution a grave and deep-seated defect, which manifests itself chiefly in imperfect or perverted nutrition; and until this is in some degree corrected, this disease can hardly be checked, or its consequences got rid of.

The cornea evinces its near alliance with the integumental tissues, by its disposition to the formation of small pimples, or *phlyctenulæ*, on its anterior surface. These, too, are most common in young strumous subjects: they are generally situated at or near the margin, and appear on the conjunctiva at the same time. They are slow in their progress, and ere they have reached their full size are generally provided with a leash of conjunctival vessels, which give a characteristic appearance to the eye. They are formed on the *front* of the cornea, and, I should suppose, immediately under the anterior elastic lamina, and the vessels they acquire also, of course, lie under that lamina, and come from the sub-conjunctival tissue.

These pimples may contain a minute quantity of lymph, which may become organized into a raised vascular tubercle, or they may advance into the pustular stage, and form ulcers by opening on the surface, with a destruction of the anterior elastic lamina and the conjunctival epithelium. An opacity remains after they are healed, which is usually proprotionate to the previous depth of the ulcer; but it is gradually lessened with the growth of the little patient, and often altogether disappears. Occasionally such an ulcer will heal with a depressed but nearly transparent surface, leaving a mark only apparent to others in certain positions of the eye, when the light is reflected from the part; but for the same reason painfully obvious to the patient himself (if it happen to be situated near the pupil) by the distortion of objects which it occasions.*

Of Opacities of the Cornea.

I shall now, gentlemen, say a few words concerning *opacities of the cornea*, such as are commonly left by a variety of causes in different portions of the corneal tissue, and shall endeavour to explain their nature and seat according to the particular tissue they affect.

We have already seen that the proper laminated tissue is capable of enlarging its vascular resources for its support under disease, and for the subsequent removal of diseased products, to such an extent that if it have itself escaped disorganization, it is able, under favourable circumstances, to completely resume its transparency. The nature of the nutritive process in the laminated tissue is such that this tissue recovers itself in a great measure, by timely treatment, from almost any amount of inflammation and consequent effusion which falls short of actual destruction of its elements. But when these elements are at all displaced or consumed under the morbid process, then permanent opacity is very likely, and indeed almost certain, to follow; for so artificial is the mechanical arrangement of the elementary lamellæ, on which the transparency of the cornea depends, that when their substance is once removed its place cannot be supplied with a tissue of an equally elaborate organization. The new material, though its bulk and strength may be equivalent to those of the old, is fibrous instead of being lamellated, and opaque instead of being translucent. It contains a considerable quantity of yellow tissue, intimately mixed with the white, and both most irregularly interwoven and ill-developed—ready to become the nidus of small granules of earthy† or fatty matter, such as readily settle in parts of deteriorated structure. From this condition recovery is not possible; the blemish has become indelible.

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* For some varieties of corneal ulceration, and other morbid conditions, *see* Appendix, Cases E, F, G, and H.

† The following is an example of ossification occurring in the centre of a dense leucoma. A girl, æt. 14, was brought to me last autumn, suffering from severe inflammation of the eye, which had been partially sunk several years before, and in which no perception of light remained. The irritation was very great, especially on every movement of the lid; and, on examination, I perceived a hard angular piece of bone imbedded in the front of a dense opacity of the cornea, and projecting beyond it, quite bare. It was easily removed with a pair of forceps, and the patient speedily got well. The fragment was the size of a large pin's head.

It is to be observed, however, that during the progress of the reparative process, there exists in the part and its immediate vicinity a quantity of fresh material of that kind which denotes an over-activity of the nutritive function, and which, not being employed for conversion into permanent tissue, will in due course be absorbed. This augments the opacity while it lasts; and it is not till a certain time has been allowed for its removal, after the healing of the breach, that we can say how extensive or deep the permanent opacity may prove; we may generally venture to predict a gradual improvement during some time, in a recent opacity, particularly in young subjects.

What I have now said applies to the greater part of the more common opacities of the cornea: I may allude to one or two other forms which may prove interesting in regard to the question of their precise seat. There are some varieties which appear to be on or near the very surface of the cornea, and which it is probable may occupy the anterior elastic lamina. The very opaque chalky-looking films which often follow the application of quicklime or new mortar to the eye, seem to be of this kind, and so, also, do those which have been supposed by some to be stainings of the surface of the corneal tissue by a deposit from the lead lotion in common use. Occasionally we have a superficial excoriation of the cornea—one can hardly call it an ulcer—which the epithelium limits with abrupt edges, thus favouring the accumulation, on the depressed surface of the frothy mucus or sud which the movements of the lid furnish. The opacity thus produced is often very opaque, and unless you were aware of its cause, might seem more serious than it really is. A lens, or the point of a needle, will inform you of its real nature.

There is another form of opacity, which I believe to have its seat in the anterior elastic lamina, although it is vain to endeavour to prove it, except by a section of the parts. It has a silvery lustre, and a very fine texture of interweaving striæ, and it creeps very gradually from near the border, over the surface of the cornea, towards the centre. The epithelial surface retains its smoothness and lustre, and the opacity does not appear to have much depth. Other varieties of opacity, very chronic in their course, and evidently not inflammatory, are liable to form, as I believe, in the same tissue. They may be of a brown tint, with an indefinite margin, and may affect both corneæ at the same time. I am not aware that these are particularly described in books, nor whether they admit of removal, or even arrest. They are probably connected with an imperfect nutrition of the eyeball, and must be left to take their course.*

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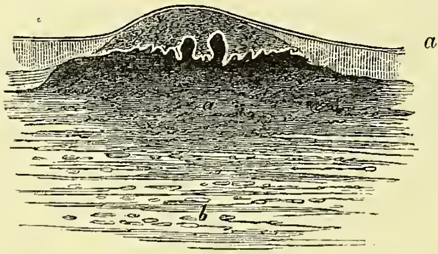
* For a case of opacity of the kind above alluded to, which I had lately the good fortune to remove by an operation, and thus to obtain the means of minutely examining, at the same time that the patient was restored to sight, I would direct the reader to the Appendix, Case I. The opacity consisted of osseous or earthy deposit. *See* also Case J.

There is a variety of opacity consisting of minute dots, sometimes so small as not to be distinguished separately without a lens; at others, as large as a small pin's head. These are evidently seated on the posterior part of the cornea, and may be referred to the posterior elastic lamina. They accompany an inflammatory affection in which the walls of the aqueous chambers seem to be chiefly involved, in which the iris is usually mottled and dull, the pupil inactive, and the sclerotica more or less injected. Such a dotted opacity was long since pointed out by Mr. Wardrop, and admits of removal, provided the proper treatment is commenced early enough. It probably consists of an ordinary inflammatory deposit of lymph.

There is still another kind of dotted opacity, occurring in the posterior elastic lamina (sometimes in the anterior also) which I would distinguish from all those yet mentioned, and which is met with in eyes which have suffered a slow disorganizing process, through sympathy with the opposite organ previously lost by operation or accident. In this the dots are remarkably round and separate from one another, often brownish, and therefore overlooked, and scattered pretty uniformly over a portion or the whole of the cornea. Though these sometimes grow fainter under appropriate treatment, I have never seen them altogether removed.*

Warty Opacity of the Cornea.

It will readily be conceived that opportunities but seldom offer of submitting specimens of the several forms of opacity to exact scrutiny by the microscope. On this account I shall make no apology for describing the appearances of an opaque spot which occurred on the front of the cornea of an Ox, and which I examined in the fresh state. It was about an eighth of an inch across, slightly raised, and densely opaque, and it seemed to have been the result of an ulcer, for the lamellated tissue was involved to a slight depth, and had been replaced by new tissue, as represented in fig. 6. This new tissue was dense and fibrous, and hardly admitted the light to pass through it even when cut very thin. It contained a large admixture of irregular nuclei and elastic tissue passing in all directions. But what was most



a, New tissue in place of destroyed lamellated tissue: papillæ are developed on it, surmounted by opaque and thick conjunctival epithelium, or, as it might be here called, epidermis. *b*, Healthy lamellated tissue below the opaque spot.

FIG. 6.—VERTICAL SECTION OF AN OPACITY OF THE CORNEA OF AN OX. MAGNIFIED SLIGHTLY.

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* Appendix, Case K.

remarkable was, that this substitute for the proper corneal tissue was thrown up under the conjunctival epithelium in the form of numerous *papillæ*, arranged in much the same way as we find them in the more highly developed parts of the skin, though, apparently without vessels, and of a texture too opaque to be precisely described. The *epithelium* over these papillæ was likewise opaque and diseased, being composed of a compact aggregation of nucleated particles, which contained numerous opaque granules, and failed to present that regular gradation from the spheroidal to the scaly figure, which is natural in this situation. The extreme surface only was scaly. I cannot help regarding this morbid condition as one of considerable interest, both as a proof of the affinities of the anterior part of the cornea to the integumental tissues, and as an example of the definite organization of the new materials into persistent forms, opaque and otherwise different from the original structure which they supplant, and incapable of remedy.*

I shall conclude the present lecture with a short description of the structure which replaces the cornea when wholly or partially destroyed, and which is liable to become bulged, so as to constitute the state known as *staphyloma corneæ.*

The whole thickness of the cornea, in a larger or smaller extent, having perished from any cause, the iris is exposed, and occupies the breach, becoming adherent to the border of the gap formed by the removal of the lost part. If the contents of the globe do not further escape, and the eyeball consequently collapse, time is afforded for reparative processes to take place, by which the opening is filled with new material by granulation. At first this new material is soft, vascular, and nearly on a level with the surrounding parts; and, if nature is allowed to proceed with her operations undisturbed, it gradually acquires firmness, toughness, and considerable density, so as to appear not unlike the original cornea, except that it is opaque. It becomes covered with an epithelium continuous with the conjunctival, just as an ulcer of the skin acquires an investment of cuticle as it heals. This process was first explained by Mr. WHARTON JONES, in an able paper published in the 'Medical Gazette,' vol. xxi. p. 847.

Now, in some cases, from causes which it is unnecessary for me at present to specify, this cicatrix contracts more or less, and continues to retain the contents of the globe within their proper bounds, the patient experiencing little inconvenience beyond the loss of vision;† but in other instances the new material begins after a time to evince its want of coherence and strength, by bulging slightly under the pressure occasioned by the accumulation of fluid behind it—that is, of course, behind the iris, in the posterior chamber of the eye. Should the projection increase beyond a certain size, it assumes an unsightly appearance, interferes with the movements of the lids, so as at last even to prevent their closure, and, in a word, grows into such a source of annoyance and irritation, that it requires to be got rid of. This is usually done by the knife, and the lens being allowed to escape, the eyeball permanently shrinks to a small size.

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* For a case, which has since occurred to me, of warty opacity in the human subject, relieved by shaving it off, *see* Appendix, Case L.

† Appendix, Case D.

The whole substance of the cicatrix being shaved off from the front of the globe, affords us, now and then, the opportunity of examining its structure in the perfectly recent state, which we can seldom do with any other of the morbid tissues of which this organ is the seat. I had such an opportunity last summer, in the case of a little girl; and the following, in few words, is a description of the structure of the tough opaque membrane which occupied the place of the lost cornea:—Its thickness was very unequal; its posterior surface, to which portions of the iris adhered, being irregularly pitted, or, as it were, worm-eaten; its anterior surface was formed by a thickish coating of epithelium, somewhat resembling cuticle, being composed of eight or ten layers of cells, the deep ones globular, the superficial ones scaly, and more like epidermic cells than those of the healthy cornea. There was no anterior elastic lamina, and no posterior elastic lamina. The entire remaining portion of the thickness of the staphyloma consisted of a dense and most irregular interweaving of white and yellow fibrous tissue, with imperfectly developed nuclei intermingled, and the meshes of the tissues large, unequal, and open on all sides.

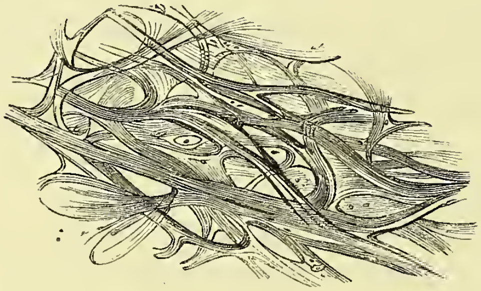

FIG. 7.—SECTION OF STAPHYLOMA; TREATED WITH ACETIC ACID: FROM A GIRL. SLIGHTLY MAGNIFIED.

In this condition we have an eminent example of those results of the reparative action, after loss of substance of the cornea, which we have already had occasion to notice as the consequence of ulcers or small sloughs, the chief difference being that here the new material is derived in a great measure, or wholly, from the vascular iris, rather than from the cornea itself. We see how far the reparative powers fall short of restoring the complex and elaborate structure of the cornea as it is originally laid down in the development of the body. The thickness of the new cuticle is attributable in part to the constant friction of the lids.

LECTURE III.

Structure of the choroid coat—its inflammatory products poured out on its inner surface, and why?—Choroidal epithelium.—Ciliary body and processes.—Course of the needle in the operations on the lens through the sclerotica.—Internal structure of the ciliary processes—their influence on the nutrition of the vitreous and lens.—The Iris—description of the iris in an albino.—Contractile tissue.—Vessels and nerves.—Mobility of the iris.—Ciliary muscle—ciliary nerves.—The Vitreous humor.—Suspensory ligament of the lens—its attachment to the capsule of the lens, with a description of the latter.—Relation of the suspensory ligament to the hyaloid membrane.—Mode of formation of the canal of Petit.—Adjustment of the eye to distinct vision at different distances.

In the preceding lectures I have described to you the structures of the sclerotica and cornea, and have endeavoured to illustrate some of the processes that occur in them in the living subject, both during health and disease. At present I propose to proceed with the parts that lie within the outer case.

Of the internal structures, the most important for the surgical student to acquire an exact knowledge of are, undoubtedly, the iris and the lens, as these both lie full in view, and are often the seat of mechanical hindrances to sight, which it is in the power of the operator to remove.

To understand the position and arrangement of these two structures it will be necessary for me to speak briefly of the choroid membrane (of which the iris may be regarded as a production), and its ciliary processes, and of the aqueous and vitreous humors.

Of the Choroid Membrane.

The delicate choroid membrane, placed within the sclerotica, between that coat and the retina, has, of course, the same general shape and curvature that these have. It is essentially a vascular coat, and consists chiefly of bloodvessels, amongst which, however, in most cases an abundant pigment is interspersed in nucleated cells, which diverge into very irregular, often branching, processes, variously inclined as regards the other tissues. A peculiar fibrous tissue is added, which holds all in place, and confers some little toughness upon the membrane.

If we remove the sclerotica and cornea from a recent human eye under water, we find that the choroid is of a dark sepia colour, slightly adherent to the outer case, near where the optic nerve passes through them both to terminate in the retina, but in the rest of its extent hardly, if at all, united to that dense fibrous membrane; except, indeed, at the anterior margin, where the sclerotica joins the cornea, and where the adhesion of the choroid is of such a kind as to require a separate description afterwards.

The exposed surface of the choroid is slightly flocculent, and some of the pigment easily separates and diffuses itself in the water. The ciliary nerves, which have pierced the sclerotica a little in front of the optic nerve, are seen now taking a forward course (having become flattened), and dividing sparingly into branches till they enter the *ciliary muscle*, which presents itself as a broad semi-transparent grayish belt intervening between the sclerotica and choroid for about an eighth of an inch all round the cornea. When the choroid has been so fully injected through the ciliary arteries that the fluid has traversed the capillaries, and also the veins, we see its outer surface to be composed of the arterial and venous branches, and its inner surface of the capillaries. The arteries, comparatively small, take a meandering course forwards between the veins, while the veins run in curves, *vasa vorticosa*, to four or five principal trunks, by which the blood leaves the organ. The capillaries form on the inner surface of the choroid a plane plexus with close meshes, known as the *tunica Ruyschiana.* This network is closer, *i.e.*, its meshes are smaller in the hinder part than in front, and the vessels finer. It is the most important part of the choroid, because the capillaries are a more important structure than either arteries or veins—more important, I mean, in regard to the function of the membrane, and also as respects its diseases. In no other part of the body are the arteries and veins so separated by a natural disposition from their own capillaries; and it is most interesting to notice, in accordance with this circumstance, that when the choroid is inflamed so that inflammatory products result, they are poured out from its inner surface rather than from its outer.*

Covering the inner surface of the choroid is a layer of *epithelium*, with more or less regular hexagonal nucleated particles, and in most cases loaded with grains of pigment. This is the *choroidal epithelium*, known also as the *membrane of the black pigment*, so called by Mr. Wharton Jones, who first observed its hexagonal arrangement. The pigment, however, you will observe, is not limited to this epithelium, but exists also in the substance of the choroid, though there the cells which hold it are irregularly star-shaped and furnished with diverging processes. In perfect albinos the same epithelium contains no pigment; while in imperfect albinos, I have observed that it contains pigment, though no other tissue in the body does. The choroidal epithelium has an organic connexion with the outer layer of the retina, to be referred to in a subsequent lecture.

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* *See* Appendix, Cases M and N.

What has now been said is intended to apply to the choroid only as far forwards as a circular line about an eighth of an inch distant from the cornea. In front of this line the choroid is covered, and more or less concealed from view, by the ciliary muscle which lies on its outer surface ; and if we divide the globe from side to side, so as to look at the inner surface of the choroid through the vitreous humor, we shall see the retina lining it as far forwards as this line, but there ceasing by a finely jagged border, *ora serrata*, in front of which the choroid is modified in appearance, assumes the name of *ciliary body*, and *appears* to come into immediate contact with the vitreous humor.

Tracing the choroid forwards, then, from the ora serrata, we find it leaving the sclerotica, being separated from it by the thin ciliary muscle, and inclining gradually inwards towards the axis of the eye, so as to encroach upon the vitreous more and more, as the ciliary muscle increases in thickness forwards.

If we examine the *inner surface* of this part of the choroid, or that towards the vitreous humor, it appears marked by striæ which are in reality very slight foldings, but are made more evident by variations in the depth of the pigment. The striæ pass from the ora serrata about three-fourths of the way towards the lens. This is the *pars striata* of Zinn. Then commence the *ciliary processes* of the choroid, which run as far as the edge of the lens, and often a little beyond the edge, so as to overlap it, but not to touch it. These ciliary processes, the *pars plicata*, are true and very decided foldings of the choroid, running in between corresponding folds of the vitreous humor, and thus taking firm hold of it. They are from sixty to sixty-five in number ; but it is impossible to enumerate them with exactness, because there intervene smaller ones of various size, some of which may be either counted or not with the rest. Examining the ciliary processes individually, each commences gradually from the striæ already mentioned, and projects into the cleft between two corresponding folds of the vitreous, increasing in depth forwards, until close to the border of the lens as it lies imbedded in the front of the vitreous humor. Arrived here, each ciliary fold attains its greatest depth, and terminates abruptly by its extreme edge changing its direction and turning forwards and outwards from the lens towards the back of the iris, with which latter it becomes continuous and then suddenly ceases. In thus bending away from the lens, each ciliary process, of course, leaves the vitreous humor, and is no longer buried in its surface and united to it, but leaves a very narrow space around the lens, in which the vitreous humor *appears* to contribute to bound the posterior chamber of the eye ; the remainder of each ciliary process, in passing to the back of the iris, likewise helping to limit the same chamber near its rim.

Thus you will observe, looking at the eye in the living subject, that a needle passed through the sclerotica towards the axis of the eye at any distance within an eighth of an inch of the cornea, would first pierce the ciliary muscle ; then, if in the hinder part of this space, it would traverse the pars striata and enter the vitreous humor; if in the fore part, it would pass through or between the ciliary processes of the choroid, and according to the direction given to it might be made to enter the vitreous humor behind the lens, or the lens itself, for the posterior chamber of the eye; but that to enter the latter without wounding the lens would be almost impossible, so narrow is the space.

Internal Structure of the Ciliary Processes.

The ciliary processes are covered with a modification of the choroidal epithelium, of a dark brown colour, which is deepest in the clefts between them, their tips being generally pale in the adult human eye, though not in animals generally. Under this is spread out a close network of vessels, continuous with those of the choroid behind, but more capacious, and therefore having a coarser appearance in an injected specimen. Their meshes follow the line of the folds. These vessels must have a great influence on the nutrition of the vitreous body and of the lens itself, from their proximity to both, and from the multiplied surface of the vitreous which they are in relation to: of which I shall give you this proof derived from a morbid process, viz., that in a case of destructive inflammation of the eye attended with the formation of lymph in large quantity on the inner surface of the choroid generally, forcing the retina inwards upon the vitreous humor, this humor itself contained throughout a multitude of those particles which appear under inflammation, and which I alluded to in my last lecture; but while the superficial parts of the vitreous were everywhere more loaded than the central parts, in no portion was there so dense a deposit of this morbid material, the result of inflammatory action, as opposite the ciliary processes and around the lens. The morbid state of the choroid was uniform, but the vitreous was chiefly contaminated in those regions in which the natural process of nutrition is most actively conducted, in consequence of their contiguity to the supply of blood.*

Such is the complexity of the parts which we are now endeavouring to understand the disposition of, that I am at some loss to determine which it will be best to place next in the order of description. Perhaps on the whole it will be most convenient for us now to turn our attention to the iris.

OF THE IRIS.

The iris, as you are aware, is a contractile curtain, suspended in the aqueous humor before the lens, with the pupillary aperture near the centre (though rather to the inner side), to give passage to the light. It may be regarded from its position as a process of the choroid membrane, although its texture is in a great degree different therefrom ; still it is continuous with that coat by its vessels and its surfaces, and it is besides convenient to the learner to consider it in this relation.

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* Case M in the Appendix.

To understand the position of the iris, we will revert for a moment, if you please, to that most important region, that key to the anatomy of these parts, the line of junction of the sclerotica and cornea, on their inner surface. Here, you will remember, the posterior elastic lamina of the cornea terminates in a network of plexiform elastic fibres which run backwards so as to form a threefold connexion—some to the sclerotica, on the further side of the circular sinus ; a large quantity to furnish the origin of the ciliary muscle; and, lastly, a smaller set, which, after bounding the aqueous humor at the rim of the anterior chamber, implant themselves into the anterior surface of the iris at its circumference. By these, then, the iris in part arises, or acquires an attachment to the outer case.

These are what I have termed the *pillars of the iris;* they are much more developed in some animals than in man, but in the human eye they nevertheless are very distinct, and to be seen without difficulty. I have drawings on the table of their appearance in several of the lower animals. In the bird they are very largely developed, and come not merely from the posterior elastic lamina, which is not thick in that class, but also from the posterior lamellæ of the cornea proper. Behind the pillars the iris is fixed to some of the fibres from which the ciliary muscle arises, and which are there passing almost directly backwards towards the tips of the ciliary processes, which last abut in the posterior chamber against the iris, and become continuous with its posterior surface. The iris is, therefore, intimately connected at its origin with the ciliary muscle ; a fact important to remember with reference to some of the functions of these parts.

The iris has two *surfaces*, which are nearly parallel ; the anterior is that which we see so elegantly bright through the cornea ; the posterior, commonly known as the *uvea*, is always dark brown, with pigment disposed in cells which form a layer easily detached, and of the nature of an epithelium, traceable into that covering the ciliary processes of the choroid. This epithelium I have seen raised in blisters by the imbibition of water after death. In the fœtus the particles are fusiform, and early loaded with pigment, except at the transparent nuclei. The posterior surface of the iris usually presents small folds converging towards the pupil, especially when that aperture is contracted. It forms the anterior wall of the posterior chamber of the eye.

On the anterior surface of the iris are to be seen many varieties of colour and even of texture, with some of which every one is familiar ; but it is not till the attention has been minutely drawn for some time to the appearances of this part that the extent of these varieties will be suspected. Much depends on the pigment, which is not only in some individuals disposed in considerable quantity on the front surface of the iris, but in all cases (excepting albinos, where no organ possesses it), is intermixed more or less with the elementary tissue of the iris, not only so as to modify the aspect of its surface, but even making it very difficult to trace the exact nature of the proper contractile material which we are quite sure exists in the membrane. And it is for this reason that albino specimens are the best adapted for examination of the iris.

Looking, then, at the eye of an albino, we observe on the front of the iris, when the pupil is contracted so as to bring the texture most completely into view, a number of elevated lines or fibres converging towards the pupil, and becoming more prominent as they approach it. As these lines are irregular in size and length, and run somewhat into one another, it is impossible to count them accurately, but they are about 40 in number. Arrived at about one-tenth of an inch from the margin of the pupil, they terminate in an irregular series of knotty prominences of similar texture, which are also joined to one another, so as to form a kind of zigzag, irregular ring, beyond which the iris is usually thinner, and marked with very fine converging and anastomosing lines which run on to the extreme edge of the pupil. In some examples, and it was so in that from which the diagram before you was taken (fig. 8), there is at the very verge of the pupil an appearance of a set of circular fibres, delicate and narrow, but sufficiently distinct, while in the majority of those specimens, which I have examined, even under high powers of the microscope, I have been unable to discover, and feel sure that there do not exist, any such constrictor fibres of the pupil. The fibres, however, in all cases, as they run to the edge of the pupil, join one another in a plexiform manner, and I am disposed to believe that this lateral junction of fibre with fibre may in effect answer the same purpose—viz., that of diminishing the central aperture of the iris—as a belt of circular fibres would do.

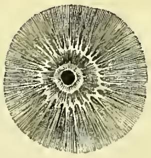

FIG. 8.—FRONT VIEW OF THE IRIS OF AN ALBINO, WITH THE PUPIL CONTRACTED IN A STRONG SUNLIGHT. SLIGHTLY MAGNIFIED.

The appearances illustrate the verbal description given in the text.

Fibres of the Iris.

The fibres which make up the proper substance of the iris are of a peculiar kind, very nearly allied to the ordinary unstriped muscle, but not by any means identical with it. They are pale, soft, easily torn and separated from one another, and are intermixed with very numerous nuclei or cyto-blasts, either circular or elongated, according to the direction of the fibres, and, indeed, very probably changing their shape in correspondence with the contracted or relaxed condition of the fibres themselves, as I have observed those to do which exist on and within the striped kind of elementary muscular fibre. In the iris we find abundance of fibres of a peculiar kind, extremely slender, looking under high powers like very fine hairs, and apparently not branching. Among these are numerous circular nuclei, and I do not know whether they are to be regarded as contractile or not.

The fibres which we see on the front of the iris, with the ring of knotty elevations in which they join each other near the margin of the pupil, all consist of fibres loaded with nuclei, and must be regarded as of a contractile nature, although they are not in all respects the same as fibres which we know to be muscular in other parts. We have, however, the certainty that there is a structure in the iris which enables it to change its form. That this is not of an erectile nature I shall be able to show you, and we have no other resource, therefore, than to consider the fibres contractile of which we find it to consist. When we further discover that the corresponding fibres in birds and reptiles are of the striped variety of muscle, we need not hesitate to admit the muscularity of the unstriped fibres of the mammalian iris; for we have the same general grounds for doing so as for admitting the muscularity of unstriped muscle in other parts, and the latter confirmatory argument in addition.

Vessels of the Iris.

The iris is vascular—about as vascular as unstriped muscle in general, and the vessels very similar in size and arrangement to those found elsewhere in like structures. They are slender, distributed among and along with the fibres, so that in a dry injected specimen you might infer the direction of the fibres from that of the vessels. Having already described the general course of the fibres, I need not detain you with that of the bloodvessels, but shall only remark that they are derived chiefly from the two long ciliary arteries, which, piercing the sclerotica behind, advance over the choroid, one on each side, in the horizontal plane of the eye, over the ciliary muscle as far as the border of the iris, near which they bifurcate, so as to encircle that part with a vascular ring, from which both it and the ciliary muscle are mainly supplied.

At a small distance from the margin of the pupil, on the anterior surface, a delicate circle of anastomosing vessels marks the line from which the membrana pupillaris passed in fœtal life, and from which it was supplied with blood. Small brown shreds or spurs of this membrane sometimes remain through life, hanging free in the aqueous humor. At the pupillary edge of the iris a minute circlet is formed by the junction of vessels of almost capillary size. From what has now been said of the vessels of the iris, it is evidently not an erectile tissue. If a doubt still remained, it would be dispelled by the fact that the iris will contract and dilate several times after death under favourable circumstances.

Nerves of the Iris.

The iris is likewise supplied with nerves, which are abundant compared with its bulk. They are branches of the ciliary nerves, which, passing through the ciliary muscle, are prolonged into the iris. Arrived here, it is not easy to trace their further distribution, on account of the pigment scattered amongst the several tissues, and also because they appear to lose that constituent which gives them their most recognizable character—viz., their double dark contour. The latter circumstance is, I think, more common in several tissues (and among them is the unstriped muscle) than anatomists have generally held; still, as the nerve-fibres do not lose their dark border all at once, they may be traced for some distance, especially in albino animals: and I have frequently found them inclining across the muscular fibres before they break up into their terminal branches, and become lost to view.

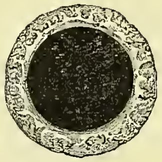

FIG. 9.—FRONT VIEW OF THE SAME IRIS AS THAT REPRESENTED IN THE LAST FIGURE; BUT HERE WITH THE PUPIL DILATED TO THE UTMOST BY ATROPINE. MAGNIFIED AS BEFORE.

Mobility of the Iris.

The great extent to which the iris is capable of moving, so as to vary the size of its pupillary orifice, is very remarkable, and is well illustrated by fig. 8 compared with fig. 9. Both these represent the same iris of a male albino, with the pupil at first much contracted under a strong sunlight, and then fully dilated by the application of a solution of atropine to the front of the eye. I have already described the appearance of the iris in the former of the two states. The distance from the greater circumference to the margin of the pupil is about one-fourth of an inch; in the latter state, it is hardly one-twelfth of an inch; while the converging striæ, and circle of knotty elevations near the pupil, are thrown into a wavy, slack condition, in which they can be but imperfectly traced. At the same time, the tissue immediately bounding the pupil is so extremely attenuated by the stretching it has undergone, as to be hardly any longer visible. The pupil itself is capable of varying from one-twentieth to one-third of an inch in diameter.

Of the Ciliary Muscle.

I now come to consider the structure and arrangement of the *ciliary muscle*—a part not known under that name, but usually called the *ciliary circle*, on account of the general doubts entertained of its real nature. Some anatomists, especially the acute and ingenious **Porterfield**, deemed it to be muscular, although in his day minute anatomy

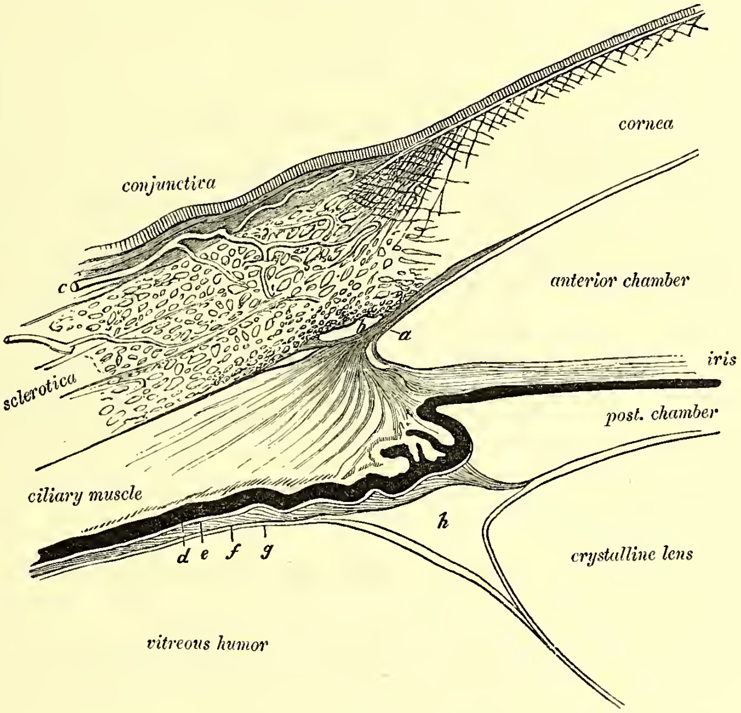

FIG. 10.—GENERAL SECTION, ILLUSTRATING THE ARRANGEMENT OF THE PARTS TREATED OF IN THE PRESENT LECTURE.

a, Fibrous plexiform tissue derived from the posterior elastic lamina of the cornea, passing to the iris, ciliary muscle, and sclerotica. *b*, Circular sinus. *c*, Conjunctival vessels, running up to the margin of the cornea, and entering the anterior portion of the sclerotica; these become enlarged in inflammation of the cornea. *d*, Choroidal epithelium on the ciliary body. *e* and *f*, The two elements of the suspensory ligament of the lens. *g*, Hyaloid membrane. *f* and *g* may be traced towards the lens, forming the anterior and posterior walls of (*h*) the canal of Petit. The capsule of the lens is seen becoming thinner behind the attachment of the suspensory ligament.

was so little advanced that no sufficiently conclusive arguments could be advanced in support of either that or any other view. Others have regarded it as a nervous ganglion, or plexus, on account of the large supply of ciliary nerves which it receives; while the greater number, especially, I think, during the present century, have been content to look upon it as a cellular or peculiar tissue, establishing a connexion between the choroid, iris, and sclerotica.

The ciliary muscle forms a greyish semi-transparent band, about one-eighth of an inch broad, on the outer surface of the choroid, between the choroid and sclerotica; for I do not admit, with some anatomists, that the choroid encloses this structure by splitting in front into two laminæ. It is thickest in front, at its anterior edge, and becomes gradually thinner backwards, terminating about on a line with the *ora serrata* before mentioned, and corresponding, therefore, on its inner surface to that striated and plicated part of the choroid in front of the retina, where the choroid takes hold of the vitreous body. The outer surface of the muscle, when exposed by the removal of the outer case, looks soft, and almost gelatinous, and it is not easy to distinguish in it anything like fibrous texture. This is partly because it is really less firm than many other muscular parts, and its fibres less separated into bundles; but partly, also, because its fibres are arranged rather in layers, of which the outer and larger, which goes from the origin of the muscle to its posterior edge, covers and conceals all the rest. But if a piece be a little raised by the knife, and then torn up by the forceps, the texture is found to give way in lines diverging from the border of the cornea more readily than in any other direction; and further, if a successful vertical section of it be made in a backward direction from the cornea, it will be seen to present more or less evidently the superposed layers as they are represented in the diagram.

Moreover, if we examine with a high microscopic power the texture of this part, we discover a fibrous arrangement in the same direction, which would be more obvious if the fibres were more separate from one another than they really are. The fibres are then seen to be loaded with roundish or oval nuclei, often precisely similar to those of the best marked examples of the unstriped muscle. Lastly, the vessels of the ciliary muscle resemble those of unstriped muscle in abundance and arrangement, and indicate in the most decided manner the backward direction of the fibres, from their origin at the junction of the cornea and sclerotica, towards the anterior region of the choroid. The vessels are derived chiefly from the same source as those supplying the iris.

The Ciliary Nerves.

The ciliary nerves, sixteen or twenty in number, divide and become flat* as they advance between the sclerotica and choroid, and enter the ciliary muscle at its posterior border. In its substance they further branch, and in a great measure terminate, running more or less evidently across the direction of the fibres, and losing their tubular character as they blend with the elements of the tissue.

Nothing can be more beautiful than the appearance of these nerves in the bird's eye; for example, in one of the common domestic species. Here the structure we are describing is indisputably muscular, as long since pointed out by Sir Philip Crampton, though at that period (more than thirty years ago) the proof derived from the anatomy of the elementary fibre was wanting. Like that of the iris in the same class, it is of the striped kind. The nerves are very large in the bird's eye, and very white; and advancing to the muscle from behind, chiefly on one side, they change their direction to one transverse to the fibres of the muscle, and are distributed among these, after forming an anastomosis with other twigs going to the circular striped fibres of the iris.

It is interesting to notice in the human eye, and in that of other animals, an uniform correspondence between the size of the ciliary nerves on the one hand, and that of the ciliary muscle on the other, though no doubt the amount of contractile material in the iris likewise shares in governing the size of these nerves. All such considerations as I have now enumerated concur in indicating the *muscularity* of the structure, thence called the ciliary *muscle.*

With regard to the use of the ciliary muscle, this is not the time to descant: but it appears to be so placed as to be likely to advance the lens, by drawing the ciliary processes towards the line of junction of the sclerotica and cornea, and also, perhaps, at the same time by exercising compression on the sides of the vitreous body. Such a movement of the lens would tend to adjust the optical mechanism of the eye to vision of near objects.

Of the Vitreous Body.

We may now, gentlemen, briefly turn to the *vitreous body or humor*—a part of considerable importance to the surgeon, in consequence of its relation to the lens. We have already seen that it occupies four-fifths of the entire globe, filling the concavity of the retina, and that the lens is encased, as it were, in its front part. We shall find, however, that this humor, delicate and almost diffluent as it is, is not the only, or even the principal agent, that holds the dense and comparatively solid lens in place, but that an additional structure, the *suspensory ligament of the lens*, is in reality the chief suspender of that organ, while the vitreous humor itself affords it little more than a bed or support for it to rest upon.

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* Near the ciliary muscle, many of the fine filaments of the ciliary nerves can be seen to consist of a single layer of nerve-tubules, arranged side by side in the substance of a very delicate layer of hyaline substance, in which is included a fine lacework of anastomosing threads of yellow elastic tissue, with brown stelliform pigment cells. The last twigs of the nerve are thus protected in their flattened and attenuated form.

The vitreous humor is perfectly transparent, and of the consistence of thin jelly; indeed, some portions of it appear to be hardly more coherent than white of egg. It is enveloped in a very delicate, transparent, homogeneous membrane, *the hyaloid membrane*, which enables it to retain its figure after removal from the globe, provided it be placed in water. The hyaloid membrane has a few delicate nuclei on its inner surface, and by this surface it adheres intimately to the vitreous substance. No vessels in the adult eye penetrate the hyaloid membrane, so that the nutrition of the humor is carried on by the vessels of the retina, and of the ciliary processes situated on its exterior.

With regard to the structure or intimate physical constitution of the vitreous humor, the general opinion has been that it is made up of an infinite number of interlacing fibres traversing it throughout, and holding water in their meshes. In favour of this view, it is said, with truth, that, if the hyaloid be punctured, the water rapidly drains off, leaving a vestige of solid animal matters; while the escape of its water is much more slow when its texture is not cut into. If the globe be frozen, the vitreous is found divided into a number of small portions, which might be supposed to be thus separated by the organic network. When, moreover, the vitreous humor is immersed for a long period in certain fluids, such as alcohol or dilute nitric acid, it becomes more or less opaque throughout, and gives some indications of such a fibrous structure as I have just alluded to. These appear to be the chief grounds on which this notion rests. It seems to me, however, impossible to discern in the fresh state, and with the best instruments, the faintest trace of fibres in this humor. I was formerly of a different opinion, but believe I was deceived by the fibrous aspect of the suspensory ligament of the lens, which is in close contact with the front of the vitreous humor. In the examination of parts so delicate and transparent, the greatest care is requisite to avoid error. The texture of the specimens rendered opaque is not fibrous, but homogeneous, and finely granular.*

The fluid collected from the vitreous humor by suspending it over a glass differs but little from water; it contains a little albumen, and some salts.

The vitreous body is in contact with the retina as far forwards as the retina extends, viz., up to the *ora serrata*, and presents a smooth surface, having but a slight connexion with the retina, by means of a layer of very transparent cells. Near the bottom of the eye, however, at that part of the vitreous which corresponds to the entrance of the optic nerve, a more intimate union subsists between the hyaloid and the outer case, by an inflection of it inwards upon a structure which advances into the vitreous towards the lens, and which, in the earlier periods of development, appears to have been a process of the retina, together with the vessels, now altogether atrophied, which supplied the lens with blood.

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* For more recent information concerning the vitreous body, see the paper on the structure of the vitreous humor in the present volume; also Appendix, Cases M and N.

Suspensory Ligament of the Lens.

But in front of the *ora serrata*, the vitreous humor comes into intimate relation with the ciliary body of the choroid, and presents a circle of folds and intervening sulci, which, for some way towards the lens, correspond accurately to, and receive those of the choroid. Nevertheless, there intervenes here between the vitreous and the choroid a special structure, which is best distinguished by the term applied to it by that excellent anatomist, Professor RETZIUS, of Stockholm, viz., *suspensory ligament of the lens.* This may be described as consisting of two layers—1st, a tough granular milky-looking membrane, clothing the inner surface of the ciliary body, within the choroidal epithelium, continuous behind, at the *ora serrata*, with the retina, but clearly not nervous in structure; and becoming gradually attenuated and lost at the tips of the ciliary processes, as these subside into the posterior surface of the iris (fig. 10, *e*); and 2nd, of an elastic, transparent, fibro-membranous structure, a production from the whole inner surface of the first, and extending as far as the capsule of the lens (fig. 10, *f*). This second fibro-membranous part of the suspensory ligament is the main support or suspender of the lens, attaching it to the whole circle of the processes of the ciliary body. It is essentially a membrane, which in its course to the lens assists in bounding the posterior chamber of the eye, separating the aqueous humor from the vitreous. But there are in connexion with this membrane a large number of flat, stiff, elastic fibres, which bend angularly like straws, and which are implanted separately into the capsule of the lens. These fibres are tough and strong, if such terms may be applied to parts so delicate; but I use them in a comparative sense.

Mode of Attachment of Suspensory Ligament to the Capsule of the Lens.

To enable you to understand how the suspensory ligament takes hold of the lens, it will be advisable to advert to the anatomy of its capsule. You are doubtless aware that the lens is a solid body of very complicated structure, enclosed in an entire and everywhere closed capsule. This capsule is the same in chemical and physical characters with the posterior elastic lamina of the cornea, with which you are already acquainted. The fibro-membranous element of the suspensory ligament is also very similar indeed in chemical characters, and I cannot help regarding it as having the like relation to the capsule of the lens as the fibrous cordage has to the posterior elastic lamina. They are intimately united, or, if you please, one is in both cases derived from, or a process of, the other. The capsule of the lens is much thicker in front than it is behind: and I shall now mention a circumstance that I believe has not been noticed before, but which bears on the view I have just expressed. It is this: that the capsule diminishes very suddenly in thickness at the line of attachment of the suspensory ligament, just as if a portion of its substance passed off in that shape,—or in other words, as if the suspensory ligament, on becoming fixed into the anterior portion of the capsule, a little way from the rim, added its own substance to that of the capsule, so as to strengthen all that lay in front of the line of its attachment. It appears that the greatest strength is needed in the front part of the capsule, as there its surface is free, and the aqueous humor can scarcely afford it so good a support as the vitreous. If we trace the capsule of the lens backwards, we find it still getting gradually thinner till beyond the rim of the hinder surface, where it becomes so attenuated as in many cases not to exceed one-quarter, or even one-sixth part of the thickness of the anterior portion.

Thus the suspensory ligament of the lens commences behind at the *ora serrata*, where its outer or granular layer seems to be continuous with the edge of the retina; it increases in substance forwards by fibro-membranous tissue derived from the inner surface of its granular layer, which layer is in intimate union with the ciliary body of the choroid; and it finally leaves the ciliary processes near their summits, to pass to the anterior part of the capsule of the lens a little within the rim, where it is fixed.*

Now, what is its relation to the vitreous body, or rather to the hyaloid membrane which bounds that body?

Relation of the Suspensory Ligament of the Lens to the Hyaloid Membrane.

The relation appears to be this; and I state it with diffidence, because the parts we are now upon are extremely difficult of investigation, and have been the source of much difference of opinion among anatomists of the greatest acumen and industry. The account of what I am now going to speak of, as well as of the structures which I have already treated of, is based upon what I have myself been able to see; and where I have succeeded in obtaining a clear view of the parts, I naturally am more disposed to rely on the conclusions I have myself formed than on those of others. I think, then, that the suspensory ligament of the lens is adherent to the hyaloid only opposite to the hinder part of the ciliary body, and that near the lens it leaves the hyaloid in order to pass to its attachment in front of the lens. The hyaloid, on the suspensory ligament leaving it, passes towards the posterior surface of the lens, and comes into contact with its capsule a little way beyond the rim, so that the rim itself, with a narrow belt of the anterior and of the posterior surface, is *free*, and a cavity is left all round the lens, bounded in front by the suspensory ligament, and behind by the hyaloid membrane. This cavity is the *canal of Petit* (fig. 10, *h*), long since discovered by the illustrious French anatomist, but about the formation of which various views continue to be held. In the description of parts so delicate it is perhaps hardly to be expected that discrepancies should not exist. In some specimens I have thought that the hyaloid grew thicker as it formed the hinder wall of this canal, and subsequently as it approached the lens, became thinner, and finally even altogether vanished from view as the observer approached the central region of the back of the lens. I do not myself believe that the hyaloid passes behind the entire lens. The substance of the vitreous seems there to touch the capsule.

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* The strength of the suspensory ligament and capsule of the lens, considered as one structure, is manifested in the not uncommon fact of the retention of the vitreous humor and lens, where the cornea has sloughed away, and where the iris, suspensory ligament, and capsule, consequently come to form the face of the organ until they are coated with lymph. Two examples of this will be found in the Appendix, Cases D and H.

Of the *canal of Petit* now mentioned, a good view may be obtained in the fresh eye of one of the larger quadrupeds, by making an aperture in the suspensory ligament, between the tips of the ciliary processes and the lens. We can then easily throw into the canal mercury, air, or coloured size (the latter is the best); the injected material runs round the edge of the lens, swelling out those parts of the anterior wall which dovetail with the ciliary processes of the choroid, and assuming a somewhat beaded appearance. The same thing may be effected from behind by running the point of the syringe through the vitreous humor and hyaloid into the canal. Either mode of preparation shows that while the anterior wall of the canal is attached to the capsule of the lens, not at its border, but a little way on its anterior surface, so the posterior wall, which separates it from the proper vitreous humor, goes to be fixed all round a little way on the posterior surface, so that the exact rim of the lens projects into the canal; forms, in fact, its inner wall, and is free, as I before stated. I say free, and it is so in the main, but I have several times seen isolated elastic fibres of the suspensory ligament passing from the ciliary processes to the very margin of the lens, and there implanted. The width of the canal of Petit is about $\frac{1}{10}$th or $\frac{1}{12}$th of an inch.*

I find that I shall not be able to give a full description of the crystalline lens in the remaining part of the time allotted to the present lecture, and I shall therefore defer that subject, and now merely detain you for a few moments with some remarks on one part of the mechanism which the eye appears to contain for its adjustment to distinct vision at different distances.

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* For some cases in which the attachments of the lens became destroyed during life, especially for a very remarkable instance in which the lens became loosened from its connexions, except at one point, and yet retained its transparency, *see* Appendix, Cases O, P, Q, and R.

Adjustment of the Eye to Vision of Objects at Different Distances.

You are aware that when we look at a distant object, the intervening ones at a less distance appear indistinct, but that when by a voluntary effort we render near objects distinct, distant ones become confused. If we use both eyes, the distant or near object which is indistinct, is at the same time double, but, with one eye, it is merely confused. In the former case the convergence of the optic axes can only be towards one of the objects at once, and the image of the other consequently falls on non-corresponding parts of the two retinæ, and is seen double. But in the latter case it is clear that the confusion arises simply from the rays from one of the objects not coming to an exact focus in the retina, while those from the other object meet exactly there, and form a distinct image, to which the attention is at the same time directed. This results from optical laws; and hence the necessity of a power in the eye to adjust its dioptric apparatus, so that objects at various distances may be brought successively into distinct view.

To enter upon a discussion of the several modes in which it has been supposed that this adjustment is or might be effected, would be now impossible. It has been thought that the antero-posterior axis of the eye is capable of elongation—that the cornea, or lens, may become more convex, or that the lens may be advanced towards the cornea by a kind of erection of the iris or ciliary processes during near vision. It is manifest that numerous purely optical considerations must occur in the examination of such a question, but on the present occasion I am concerned rather with such arguments as the anatomical construction of the eye may contribute, towards the solution of the difficulty; and I may be allowed to insist on the extreme and primary importance of such arguments in all similar questions, provided they are grounded on a correct appreciation of the facts.

We have, then, it appears, within the globe of the eye a structure which is in all probability muscular, and which is undeniably so in certain animals. It has the arrangement of a muscle, very much the structure of a muscle, and is largely supplied with nerves, which are in great part derived from a motor source—the third pair. This muscle arises, or has its most fixed attachment, at the junction of the sclerotica and cornea, as much in front of the lens as is possible consistently with the preservation of the transparency of the cornea. That it may act more freely, a canal, the *circular sinus*, is interposed between its origin and the portion of the sclerotica which it lies against. Beyond this point it is hardly at all attached to the sclerotica, over which its fibres may be supposed to move in contraction, but it covers, and is inserted into, the anterior $\frac{1}{8}$th of an inch of the choroid membrane, which is in this part tougher and firmer than elsewhere, and united in a very special manner to the lens by the ciliary processes, through the medium of a firm tough membrane, and of a strong elastic fibrous membrane proceeding from it to the margin of the lens. And yet not quite to the margin, for an elegant arrangement exists, the canal of Petit, by which traction is made, not on the vitreous around the lens, nor on the edge of the lens itself, so much as on its anterior surface. I confess it seems to me very difficult to doubt that this complicated system of parts is intended to advance the lens towards the cornea, so as to bring forwards, up to the retina, the focus of a near object, which would otherwise fall behind the nervous sheet. It is possible, also, I think, from the peculiar direction taken by the ciliary muscle, that it may compress the front of the vitreous, and thus help to throw forwards the lens.

LECTURE IV.

Of the Crystalline Lens.—Position, shape, size—Anterior chamber small in infancy—Occasional consequence of this. Capsule of the Lens—Experiment illustrating its endosmodic power and its elasticity—Thickness not uniform—Proneness to opacity during Life—Characters of the opacity. Body of the lens—Its fibres and laminæ—Nucleus—Central planes—their use—their complexity in the human lens—Mode of union of the fibres—Use of the toothed margins—Intra-capsular cells—The "liquor Morgagni" a result of disease or post-mortem change—The "capsule of the aqueous humor" does not exist—Remarks on some appearances of cataractous lenses.

Gentlemen,—We proceed to-day with the consideration of the structure of the crystalline lens and its capsule; a subject not more interesting to the anatomist than to the ophthalmic surgeon, on account of the large share of his attention which that important and common disease, the cataract, must always engross.

The crystalline lens, you will remember, is placed at the front of the vitreous body behind the iris, and is held in place there chiefly by a special fibro-membranous suspensory apparatus passing between its capsule and the ciliary processes, but partly by its adhesion to that portion of the vitreous body which is hollowed out to receive it.

Size and Shape.

The lens is an almost perfectly transparent structure, about one-third of an inch wide and one-sixth of an inch thick, more convex behind than in front. It has been doubted whether the curves of the lens are spherical or spheroidal; a question of much interest with reference to the corrections of an optical nature of which the eye is the seat, but not strictly bearing on the object before us in these lectures. The most accurate admeasurements, however, of the mammalian lens, which are those of Chossat, make it probable that the figure of the human lens is like that generated by an ellipse revolving round its lesser axis, the curvature being greater for the lateral than for the central parts.

The lens in early life is soft and nearly spehrical, and grows larger and flatter with age, as well as harder, and somewhat amber-coloured. These circumstances should be remembered with reference to the diseases of the part at the several periods of life. The globular shape of the infant's lens renders the aqueous chambers small, and brings the iris almost into contact with the cornea; but in the adult the iris is usually not at all thrown forwards by the prominent centre of the lens. Nevertheless, in persons of full or declining age, who are the common subjects of hard cataract, the surgeon is accustomed to meet with very varying dimensions of the anterior chamber. This, however, depends rather on variation in the size of the lens than in its shape, and sometimes a prominent iris betokens an enlarged vitreous body, or chronic engorgement of the ciliary body of the choroid.

In consequence of the prominence of the lens in infancy, it sometimes acquires a minute opacity in the very centre or most prominent point of its anterior surface, from coming in contact with the cornea, where this membrane is inflamed in cases of purulent ophthalmia. There is often a corresponding speck on the posterior surface of the cornea, precisely opposite.*

Of the Capsule of the Lens.

The lens is enclosed in a capsule of perfectly transparent, homogeneous, and very elastic membrane—a part that should engage the special study of every one who proposes to operate on the eye. It is an entire unbroken layer, separating the lens from all that surrounds it, but very permeable by fluids, and, therefore, the medium through which the nutrition of the lens is carried on. Its elasticity, which is one of its most remarkable properties, is evinced by a curious experiment which presented itself to me accidentally when I was occupied in a series of researches into the anatomy of these parts. When removed from the eye, and placed in water, the lens imbibes fluid through its capsule, which thereby becomes distended and separated from the contained lens, being raised in the form of a vesicle. If it be taken from the water, and punctured with a needle, the fluid is ejected with violence by the resilience of the distended capsule, which instantly contracts to its former bulk, and grasps the lens closely. The capsule is also very brittle, is easily torn in any direction when once a breach is made in it, and yet very tough, so as to offer considerable resistance to a blunt instrument which may be thrust against it.

We see these points exemplified in the operations for cataract and artificial pupil. In the former, when the sharp-pointed needle touches the capsule (provided the membrane be sound), it enters and tears it with the utmost facility; while in the latter, the blunt hook often used to engage and draw aside the pupillary margin of the iris seldom does any injury to the capsule, though it must almost always touch it, and that sometimes somewhat rudely, in spite of the operator's caution. When ruptured, the capsule rolls up at the edges, whatever the direction of the laceration, and it is curious that the outer or convex surface always lies innermost in the roll, so that, like the posterior elastic lamina of the cornea, which it nearly resembles in other respects, it appears to be developed or laid down in a curve contrary to that which its elasticity inclines it to assume.* It is a hard and dense structure, and determines the exact outline of the lens.

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* *See* Cases S, in the Appendix.

Thickness of the Capsule not Uniform.

The thickness of the capsule of the lens is different in different parts; particularly it is thicker in front than behind. This I alluded to in the last lecture, in speaking of the suspensory ligament or zonule; but I shall here repeat it, because of its importance. The anterior part of the capsule in the greater portion of its extent, in all its central region, and as far outwards as to within one-sixteenth of an inch of its margin, where the suspensory ligament is attached, is four or five times thicker than the posterior part. The diminution in thickness commences rather suddenly at the attachment of the zonule, and continues gradually as you proceed over the border to the posterior surface, where the minimum thickness is soon attained. This I have ascertained by careful examination. I need hardly point out to you how a knowledge of this fact may help us to understand some of the morbid processes met with in this part, and, by indicating with precision the direction in which lies the chief strength of the support of the lens in its position, may aid the surgeon, and give him confidence in certain of his nice and delicate manipulations.

The Capsule retains its Transparency after Death, but is prone to lose it during Life.

The capsule of the lens retains its transparency under the action of acids, of alcohol, and of boiling water, and will resist the putrefactive process for a great length of time: at least, I have frequently found it remain transparent after the lens itself had been completely destroyed by putrefaction, and the centre of the lens is itself very slow to putrefy. But, however difficult it may be to render the capsule opaque after removal, it is rather prone to become so in the living body. An injury, such as laceration or puncture, is there almost sure to be followed sooner or later by a loss of its transparency, and we often see it of a decided dead white. The same also occurs in many cases where the opacity is primarily in the lens itself. After the operation for cataract by the needle, this opaque capsule is a not infrequent source of annoyance to the surgeon, obstructing the access of light to the retina, and demanding removal.

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* For a post-mortem examination of an eye in which the operation of solution had been performed, *see* Case T, in the Appendix.

This proneness of the capsule to become opaque only while it continues a part of the living body, seems to show that, hard and structureless as it appears, it is yet the seat of unceasing nutritional change—that its substance is in continual flux; for we can only regard the opacity as a result of depraved nutrition, the new material being laid down in an abnormal form.

In some rare examples, one of which presented itself here during the present summer, minute vessels are developed upon the capsule, probably in lymph previously deposited there as a consequence of inflammation. They are continuous with those of the ciliary processes or adherent iris.

It is interesting to observe that the opacity is usually denser when it takes place in the anterior part of the capsule, than when in the posterior, because of the greater thickness of the former portion. But, besides this, the anterior seems more prone to become opaque than the posterior.* When opacity occurs, the capsule usually loses its brittleness and becomes tough. The opacity assumes an irregular figure, in flakes or patches, if the body of the lens remains, and may thus be distinguished from a similar change in the lenticular substance; but the opacity is more uniform if the capsule has been rent and the body of the lens absorbed. The opaque parts may even become so completely altered from their original texture as to be the seat of earthy deposits; but this is rare.

Of the Structure of the Body of the Lens.

If we now turn our attention to the lens itself, that solid transparent mass thus enclosed and protected, we find it to be soft and pulpy in the outer portions, more firm, dense, and glutinous towards the centre, which is distinguished as the nucleus. Not that there is any special plane of division between the nucleus of the lens and its exterior or superficial portions: the change to more and more density is very gradual. No language derived from other objects can adequately describe the precise texture of the lens, as appreciated by the finger, simply because it is not a homogeneous texture, but one highly complicated and peculiar, which it will require some attention to understand.

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* *See* Case T, in the Appendix.

Fibres of the Lens.

The lens is composed of flattish riband-like albuminous fibres, having an average thicknes of $\frac{1}{5000}$th of an inch, united side by side, so as to form plates, which are placed one within the other, somewhat like the leaves of an onion. The fibres all pass from the front to the back, so that each has two extremities, an anterior and posterior; and a middle part, which is directed towards the side or rim of the lens. In the lens of simplest construction—the spherical or spheroidal lens of many fishes, reptiles, and birds—the ends of the fibres all meet in the antero-posterior axis; and the surface of such a lens, viewed either before or behind, has the appearance of a globe marked by the lines of longitude passing from pole to pole. The same appearance, too, is seen after removing any number of the layers of fibres down to the centre. The individual fibres are of course narrower at the extremities and broader in the middle; and they would come to quite a point in the axis were it not that their lateral union becomes so intimate as they approach it, that the eye can no longer distinguish them individually, nor the skill of the anatomist isolate them. Moreover, it would appear that those coming from opposite sides do not form a firm junction across the axis, but rather that the axis is occupied by a substance of less density than the fibres themselves; so that, under ordinary circumstances, the lens may be made to break up, and its opposite sides to fall asunder along that line. In the lenses I am now referring to it is not uncommon to find a cup-shaped depression—a kind of crater at each pole; but I have never seen this so large as in the prolate-spheroidal lens of the Cuttle Fish.

Nucleus of the Lens.

It is further to be observed that the individual fibres become narrower and denser, as well as more intimately held together, as they approach the centre of the lens; and it is obvious that they must also become shorter and shorter. The degree in which their density augments varies, however, very widely: in the bird, for instance, it is far less than in the fish: so that the lens of the former is soft and pulpy, even to the centre, while the nucleus of the latter is often of almost stony hardness.

What I have now said as to the shape and texture of the lenticular fibres applies in general to the eyes of most animals. These fibres are always narrowest at their ends, shorter and denser towards the centre of the lens. The mode, however, in which their extremities are arranged at the poles, exhibits many very curious modifications of the use and meaning of which I am not aware that any explanation has hitherto been offered.

Central Planes.

The first departure from the simple arrangement already mentioned—in which all the fibres diverge from, and terminate in, the antero-posterior axis of the lens—is met with in some fishes and some mammalia, of which the Porpoise is one. Looking at the front of the lens, we see a straight line passing through the pole, and reaching about one-quarter or one-third of the way towards the margin or equator on each side. From this line the fibres diverge in an uniform manner, and, passing over the edge, may be traced converging on the opposite surface to a line of similar length passing through the pole, but at right angles to the first, so that if the one is vertical the other is horizontal. This being so, a moment's consideration will enable you to understand that none of the fibres reach half round the lens—that, for instance, one which starts from the anterior pole (or the centre of the anterior line) cannot reach the posterior pole, but terminates at the extremity of the posterior line; while one which starts from the end of the anterior line is necessarily brought to the posterior pole; and the intermediate ones in a similar manner, according to their position. Now, if we remove the more superficial strata of fibres, we still find the deep-seated fibres diverging from similar lines, and discover, in fact, that the lines seen on the surfaces are but the edges of planes which penetrate even to the central region of the lens, these planes being productions or expansions of that axis in which, in the spherical variety of lens, all the fibres meet.

Object of the Central Planes.

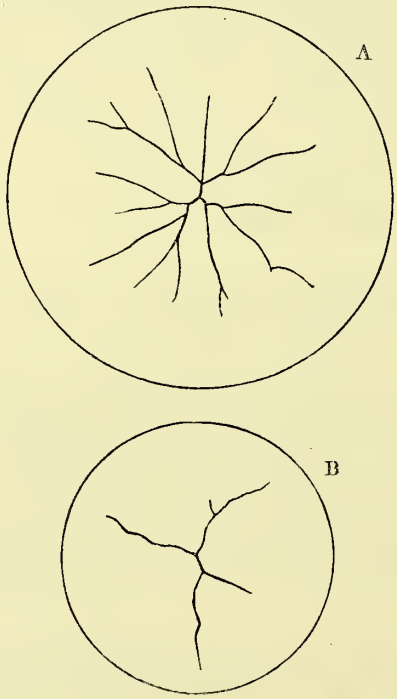
These planes are widest where they appear on the surface of the lens, and are gradually narrower inwards; and those of opposite sides meet, although at right angles, somewhere in the antero-posterior axis, at a point the position of which (or, in other words, the respective depth attained by the planes) is determined by the various curvatures of the opposite surfaces of the lens. But as every fibre has in each plane a point answering to one of its extremities, it follows that the area of the two planes must in all probability be equal, and therefore that where one plane passes from the surface more deeply into the lens, the other must extend from the pole more widely towards the margin.

It certainly appears to me that the expansion of the axis into the planes now described, and the concomitant complexity of the arrangement of the fibrous constituents of the lens, are designed to furnish the mechanical means of modifying the curvature of the surfaces of the lens. It would appear that by carrying the points of termination of many of the fibres away from the antero-posterior axis, and towards the margin of the lens, this axis is shortened, and the surfaces are rendered flatter in the middle part than towards the edge; are made to resemble ellipsoids of revolution round the lesser axis, rather than spheres; and this in a degree proportionate to the extension of the central planes towards the circumference. Thus we have the central planes wider in front than behind, in correspondence with the greater flatness of the anterior surface.

If we pass to the examination of other lenses, further modifications of the axial planes, and consequently of the arrangement of the fibres, are met with. For example, in some of the cetacea I have found the planes to bifurcate irregularly, and to a variable extent, towards the margin of the lens—a disposition not, I believe, before observed; but the most elegant arrangement is certainly that well known one of the mammalia in general, in which three equidistant planes diverge from the axis, those of the front and back holding intermediate positions, precisely as in the more simple case already described.

Their Complexity in the Adult Human Lens.

But of all the specimens that have come under my own observation, those of the adult human lens have presented the greatest multiplication or subdivision of these planes; for while our own lens adheres to the ordinary mammalian type in possessing a triple divergence from the pole, each of the three planes is almost immediately



A, Division of central planes as seen on posterior surface of an adult human lens.

B, Same from the fœtus of nine months.

FIG. 11.

branched, if I may use the term, and this not once only, but twice or more, so that instead of three segments we have as many as twelve or sixteen, the numbers being irregular no less than the course, direction, and extent of each.

Fig. 11, A, copied with accuracy from an adult human lens, will convey a better idea of the arrangement of these planes than mere words can express ; and if you will endeavour to picture the opposite surface as if seen through this one, and intersected with a somewhat similar radiation of planes, placed intermediately to these and receiving the opposite ends of the fibres, you will understand the extraordinary intricacy of the construction of this organ in our own eye.

Their Simplicity in the Human Fœtus.

I may mention in this place an interesting fact which I noticed in comparing the fibres of the fœtal and adult lens in the human subject. It is this, that as development proceeds, and the lens becomes wider and flatter, the central planes extend themselves further and further from the axis, and at the same time branch again and again, so as to multiply the segments, into which they divide the lens. (*See* fig. 11, B.)

From this it may be inferred that the multiplication of the mesial planes outwards is a process necessary to the expansion and flattening of the organ, and takes place by the deposition of new fibres on the old; and also, that even in the adult lens the planes remain simply tripartite in the nucleus, being only multiplied in the more superficial layers.

Having thus endeavoured to convey to you some general idea of the arrangement of the lenticular fibres, we will consider briefly the mode in which they are united into the forms I have described, and organically attached to the capsule; for it would be a mistake to regard them, as we are apt to do, simply in the light of independent parts placed in artificial juxtaposition. And more especially is it necessary to consider the lens as a whole, if we would form a correct notion of the actions which contribute to the maintenance of its organic life, and comprehend the reason of the alterations of texture which it exhibits under accident or disease.

Mode of Union of the Fibres.

As the ends of the fibres approach the central planes in which they terminate, they are found to be more or less fused together into a solid hyaline mass, which retains only for a short way a trace of the interval between the contiguous fibres. Sometimes the fibres may be torn up as far as the central planes; at others they break off short, rather than split up, as they approach the planes: and this is more the case towards the nucleus. Near the planes, therefore, we cannot properly say that they have a well-defined border or limit; but in the intermediate portions of their extent their edges are found to be doubly bevelled, so that one fibre is adapted by each of its edges to two other fibres—one a little above, and the other a little below it; and if we consider these bevellings as separate sides, each fibre would be six-sided. But we further remark that the bevelled margins are more or less jagged, and that the projections and sinuosities of the opposed fibres mutually interlock. Thus each fibre is intimately united by its toothed edges to four others, and by its smooth flattened surfaces it touches two others—one over and the other under it. The lateral union of the fibres, being the more intimate, determines the division of the lens into layers enclosed one within another, rather than into segments. But if we obtain a fortunate view of the fibres *in situ* and in section, it is easy to perceive that the lateral junctions of the fibres of successive layers lie in regular order one within another; and that if the splitting of the lens could be made to follow these joinings, we should reduce the organ to a number of segments, the thickness of which would correspond with the width of one fibre.

The indented margins of the fibres are much more obvious, and are no doubt really much more developed, in some classes of animals than in others. It was in the eye of the Cod that Sir David Brewster first detected them, and they are nowhere more evident. The teeth have a certain average size; but, like those of the cranial sutures, they are irregular in shape, and have been manifestly formed by the shooting together of contiguous parts during growth. In the lens of the bird, and in that of mammalia and Man, they are even less regular in shape, and far less defined; and it is often difficult to see more than a soft gelatinous margin. The toothed borders are usually most apparent when the albuminous basis of the fibres has been hardened by heat, or a chemical reagent.

Use of the Toothed Margins of the Fibres.

What, now, is the use of the serrations of the fibres of the lens, and why do they exist only at the sides? In the fish, which has the fibres very flat, and consequently with thin edges, and a small surface for lateral contact, the teeth are large, stiff, and well defined; whereas in the higher animals, where the fibres are thicker, and their bevelled edges present a broader surface of union with those on either hand, the teeth are softer and less developed; and in all cases the broad surfaces of the fibres are not toothed at all. We may therefore regard the serrations simply as an artificial mode of increasing the points of union between the edges of the fibres according as their thickness or thinness renders necessary. If the fibres had been six-sided, and the sides equal, we may suppose, either that there would have been no teeth at all, or, if any, that they would have been developed to an equal extent on all the sides. Thus far, perhaps, it is legitimate to speculate on the final cause of this remarkable and elegant structure.

Intra-capsular Cells of the Lens.

Immediately within the capsule, separating it from the superficial fibres, is a layer of cells, extremely thin and transparent, of unequal size, and nucleated. These cells form an organic union between the body of the lens and its capsule, and it is through them that the nutrition of the fibrous part is conducted. It is by the multiplication and successive transformation of these cells into fibres that the body of the lens increases in size; and when its growth is complete, a single layer of them remains. The superficial fibres, even of the adult, often retain some of the nuclei, in an extremely transparent form, at pretty regular distances in their substance.

The "Liquor Morgagni" a result of Disease or Post-mortem change.

When, after death, the lens is placed in water, or allowed to lie in contact with the aqueous humor, the water passes through the capsule, and distends and bursts these cells, collecting between the lens and the capsule, and raising the capsule as I mentioned at an earlier period of the lecture; but no fluid exists during life between the capsule and fibres of the lens, except what belongs to the texture of the cells. There is, then, no such fluid as the *liquor Morgagni* in the healthy lens. When this fluid exists in the cataractous lens, between the body and the capsule, or when it is found there after death, it is to be regarded as a morbid or false condition, indicative of the destruction of the layer of cells which has been just described.

The "Capsule of the Aqueous Humor" does not exist.

Some authors speak of another layer of cells on that portion of the outer surface of the capsule which contributes to form the posterior chamber of the aqueous humor behind the iris, and they consider it to resemble, and to be a continuation of, the epithelium lining the back of the cornea, and which I have termed the epithelium of the aqueous humor. Such a layer has been imagined necessary to the completion of that serous sac which has been very generally supposed to enclose the aqueous humor, and which has passed under the name of the *aqueous capsule, or capsule of the aqueous humor.* Now, with regard to its existence on the front of the lens, I can only say that I have sought for it with great care, but in vain; and I therefore do not believe that it exists. Taking the perfectly fresh eye of a large animal, I have removed the cornea by a circular cut with scissors, without allowing the cornea to touch or rub against the lens. I have then, with equal caution, cut away the iris, so as fully to expose the front of the lens; I have then most carefully made a circular incision in the front of the capsule, near its rim, and have placed the portion so detached on glass, flat or variously folded, and always without being able to distinguish any trace of such cells. Now, with far less nicety, it is most easy to see the posterior epithelium of the cornea, and the intra-capsular cells of the lens; and the evidence, therefore, seems to me sufficient for disbelieving in the existence of the layer now spoken of; particularly as I am not aware that any author who has described it has stated that he has actually seen it.

I shall now say a few words on some varieties of cataract, the appearances of which (capable of being discriminated during life) derive illustration from what I have now explained of the structure and arrangement of the lenticular fibres.

Remarks on some Appearances of Cataractous Lenses.

1. The congenital opacity of the lens, so frequent in children, affects the entire substance. We may sometimes, though rarely, observe upon its front surface the simple trilinear division into segments which, in the human subject, is peculiar to early life.

2. In the commencing cataract of middle or declining age, we not uncommonly find the posterior surface of the lens first affected, so that we look through the transparent lens upon an obviously concave opacity. This opacity sometimes, and indeed generally, encroaches from the margin in distinct streaks of irregular thickness, length, number, and distance apart; and we usually find that, when the pupil is widely dilated by belladonna, some at least of these streaks are traceable round the margin for some way over the anterior surface. So long as small portions of the hinder surface of the lens remain clear, the body and front being also clear, it is surprising how much visual power may remain. At a subsequent period, the centre

of the lens begins to be cloudy, and then the progress towards blindness is more rapid. Now I can entertain no doubt that the streaks in these cases are sets or bundles of the superficial layer of lenticular fibres, reduced to a state of opacity by some nutritional change. There seems to be a disposition in the fibres of the lens to become opaque in their entire length when once they are morbidly altered at a single point: and hence the linear figure of the opacity. The opacity probably commences in the middle part of the fibres near the margin of the lens; and the arrangement of the fibres would account for the different length of the streaks, some approaching nearer than others to the central point on the surface.

3. In another variety of opacity in adults, there are streaks visible, either on the anterior or posterior surface, before the nucleus manifests any tendency towards dulness, but instead of converging from the border of the lens, they rather diverge from the central point. These streaks are also irregular in number and direction; and it has never occurred to me to distinguish in them any exact representation of the edges of the mesial planes as they are seen on the surface of the prepared lens; never, certainly, any trilinear figure. But a glance at the representation previously given of the complex arrangement of the mesial planes in the adult human lens, will suffice to explain why they are rarely seen in such opacities. In the healthy lens they are in reality too near together, and too irregular, to be detected without a glass. The triple divergence from the axis can, even then, only be recognised for a short distance, beyond which the planes seem to diverge and branch without any attempt at geometrical precision. We cannot, therefore, wonder that an opacity, spreading from the centre of the surface of the lens, and which consists of broad, ill-shapen streaks, should fail to disclose the radiation of the mesial planes: although it seems highly probable that its seat is, primarily and essentially, rather in the edges of those planes than in the fibres themselves.*

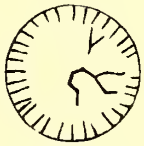


FIG. 12.—CATARACTOUS LENS, IN WHICH THE OPACITY FOLLOWS SOME OF THE DIVISIONS OF THE CENTRAL PLANES OF THE LENS, AND SOME OF THE FIBRES AT THE CIRCUMFERENCE. THE PUPIL DILATED BY ATROPINE. MAGNIFIED TWO DIAMETERS.

4. In the lenticular cataract of adults, the glistening, silky, fibrillation of the lens

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* Since this lecture was delivered, I have seen two cases (one under the care of Mr. DIXON) in which the opacity radiated from the centre in clearly-defined branching lines, corresponding exactly in character with the branchings of the central planes. The opacity was confined to the surface of the lens, and did not dip in the direction of the planes; neither did it occupy all the divisions of the central planes. It was accompanied, in both cases, with other streaks of opacity at the border of the lens, evidently in some of the fibres.

may be often seen; but you will fail, even in the best-marked of these cases, to discover, with the naked eye, anything like regularity in the mode in which the fibres pass off from the central region. Before becoming acquainted with the complex arrangement of the planes of the human lens, I could not satisfy myself why the triple line of the mammalian lens should be unseen; but the actual complexity is a sufficient reason. It explains, too, the appearances of many cases of opacity of the body of the lens, where the fibrous texture is in general obvious enough, but where, towards the centre, an amorphous, indefinable obscurity exists.

LECTURE IV.

Concluded.

Of the aqueous chambers—morbid cyst of the iris—aqueous fluid—its source—removal of blood effused—if coagulated or not—if chambers are occupied by serum. Of the retina—vascular and non-vascular coats. Common elements. 1. Grey fibres and their evolution from the optic nerve. 2. Grey vesicular matter. 3. Caudate nucleated vesicles. 4. Agglomerated granules divided into granular and nummular layers, with intervening pale stratum. Peculiar elements. 5. Rods. 6. Bulbs, in man and animals. Of the Yellow Spot—modification of the layers of the yellow spot—colour where situated.

Having concluded what I had to say on the structure and arrangement of all the parts which bound and form the aqueous chambers of the eye, we may proceed to consider very briefly the shape and contents of these chambers themselves.

Of the Aqueous Chambers.

The chambers are that cavity in the eye occupied by the aqueous humor, and lying between the cornea in front and the lens with a portion of its suspensory ligament behind, and they are divided from each other by the iris, but communicate through the pupil. The cornea bulging forwards away from the iris, and the lens bulging forwards towards it, or even up to it, cause respectively the large and small size of the anterior and posterior chambers; but, besides this, the circumference of the anterior chamber is much wider than that of the posterior, by reason of the much nearer approach of the ciliary processes than of the pillars of the iris, towards the axis of the humors.

To speak more particularly of the limits of the two chambers, the *anterior* is bounded in front by the posterior epithelium of the cornea coating the posterior elastic lamina of that structure. At the border it is limited by the passage of a part of this lamina to the front of the iris, the epithelium being very imperfectly, or not at all, continued over that part. Behind, it has the anterior surface of the iris, which I believe is not invested with any definite epithelial structure distinguishable from its own peculiar fibrous and nucleated tissue, but is, as it were, bare and exposed to the contact of the aqueous fluid,—so that in cases where we are able to perceive the delicate fibrous cordage of the iris, as if elegantly dissected, in the natural and living eye, this cordage is not seen through a film of epithelium; and, in those instances, especially of the darkly-tinted eye, where the interior arrangement of the iridial fibres is unseen, it is simply concealed from view by the quantity of pigmentary particles accumulated both in its interior and on its surface, not more on the latter than in the former, and not on the latter in the nature of an epithelial lamina.

In the fœtal eye, previous to the seventh month, and imperfectly at a later period, the *membrana pupillaris* passes across the pupil, and closes the anterior chamber, then very small. It passes from a circle on the front of the iris, a short way from the true pupil, where the knotted appearance of the fibres is so often visible in the adult eye, and where it sometimes leaves faint traces of its existence throughout life, in the form of minute threads or spurs standing off from the original line of attachment into the aqueous humor.

The *posterior* chamber is bounded in front by the surface of the iris, on which is a layer of epithelium, loaded with dark-brown pigment, and easily separable from the proper tissue of the iris. If we place a fresh human eye in water after having divided it through the middle, it is not uncommon to find this layer of pigmented epithelium rising in the form of a small blister from the surface of the iris, in consequence of the imbibition of the water; and sometimes after death the same thing occurs, from the imbibition of the aqueous humor just as the aqueous humor is generally absorbed into the capsule of the lens, and distends it under the like circumstances.

Cyst of the Iris.

I may here mention a very remarkable and interesting, but rare, disease of the iris, which appears to me to consist in the morbid formation of transparent fluid between the iris and this posterior layer of epithelium (the *uvea*, as I omitted to say it is called). This disease is not accompanied by any other, is of slow progress, and appears first as a bulge of a portion of the iris towards the cornea. I imagine that the first formation of the fluid is attended with a swelling of the uvea backwards towards the suspensory ligament and lens; but, as the contact of these resisting parts must very speedily arrest any further advance in that direction, the accumulating fluid next begins to push forward the proper tissue of the iris, which separates it from the anterior chamber. Here it meets with less resistance. The highly extensile fibres of the iris slowly yield, until in the course of months they bulge to a large extent before the fluid, and come into contact with the cornea, and that sometimes so widely as to throw the pupil towards the opposite side, and even to put it out of sight, by becoming rolled in front of it. A case of the disease is given by Dr. Mackenzie (Case 263, 'Practical Treatise on Diseases of the Eye'). If the cyst be punctured in front, the transparent contents are ejaculated with force by the undiminished contractility of the distended iris, and in the course of a few minutes there remains no trace of the pre-existing disease, the iris having in all respects resumed its natural aspect. The cavity however is apt to refill more than once. In Dr. Mackenzie's case, it was punctured a second and third time, at intervals of six or eight weeks, and afterwards never returned, vision being perfectly restored.

It is evident in this disease, that the muscular tissue of the iris is expanded over the fluid, and, therefore, the characters of the disease give no support to the opinion that the iris is invested in front with a serous membrane (aqueous capsule). If the wall of the vesicle were simply a serous membrane, it would not so immediately contract on being punctured; and besides, during the process of contraction the membrane can be seen gradually assuming the well-known fibrous aspect of the iris. It is also evident that the uvea (which is always dark) is not protruded with the muscular tissue, but separated and thrown posteriorly; for, if it were in front of the fluid of the vesicle, its pigment would be obvious enough in the attenuated tissue, whereas it is not visible there.

But to return from this digression: the uvea thus bounding the posterior chamber in front, does not line the iris or the posterior chamber after the manner of a serous membrane, *i.e.*, it is not reflected from one part of the chamber wall to another, but appears to be a continuation of the epithelium of the choroid, as it may be traced to the iris from the ciliary processes. In the adult it has not usually so regular a form as where it lines the choroid, but in the fœtus it consists of spindle-shaped cells, with central transparent nuclei, and with dark pigment filling up all their other part.

Between the tips of the ciliary processes and the lens, the suspensory ligament of the lens, forming the anterior wall of the canal of Petit, bounds the posterior chamber, which is completed by the front of the capsule of the lens. Neither of these structures is covered by any epithelium, both being in immediate contact with the aqueous fluid.

Aqueous Humor: Its Source.

The aqueous humor itself is little more than water, less than $\frac{1}{50}$th of its weight being solid matters (chiefly chloride of sodium). Thus, it is very different from the serum of blood, and may be strictly regarded as a secretion, depending for its integrity on a healthy state of the parts which furnish it. What these parts are, it is difficult to define with accuracy, although doubtless they are a portion of the walls of the chambers in which the fluid lies. It seems to me to be certain that portions of both anterior and posterior chambers secrete this fluid, not merely because it is found in both before the removal of the membrana pupillaris, but also from the fact, which we see in practice, that after the complete closure of the pupil by adhesive deposit, both anterior and posterior chambers may retain their aqueous fluid.* When the pupillary margin has become adherent to the lens, we very frequently find the contents of the anterior chamber recovering their natural condition. But it may not be so generally known, that in some cases of slow enlargement of the globe, and distension of the anterior portion of the sclerotica, consequent on perforating ulcer of the cornea, and obliteration of the anterior chamber by adhesion of the iris to the corneal cicatrix, the aqueous humor, secreted into the posterior chamber in too great abundance, but in a natural state as regards its quality, is the occasion of the enlargement. It appears probable from their structure, that the posterior surface of the cornea, and both surfaces of the iris, with the tips of the ciliary processes, are all concerned in the formation of the aqueous humor, and that the suspensory ligament of the lens, and the anterior capsule, do not share in this function.

Blood Effused into the Chambers.

It is a wonderful thing to see blood which has been poured into the aqueous chambers by some accidental blow upon the eye, disappear in the course of a few days by solution in the aqueous fluid and absorption. If the organ escapes active or disorganizing inflammation, a week or ten days are often sufficient for the removal of blood which has nearly filled the chambers: but something even then will depend on circumstances. If the blood has coagulated into a firm clot, its absorption is retarded. I had recently a case in which a young man had an injury to the eye late in the evening, but soon after went to bed and slept soundly. When I saw him next morning, I observed that he had been sleeping on his right side, for the blood had formed a clot, occupying about the right two-thirds of the chamber, and bounded by a very sharp but somewhat concave or cupped edge, placed vertically. It was remarkable that the iris (at least the uncovered portion of it) remained freely moveable. When the pupil was contracted by a strong light, he was blind with this eye, but the eclipse of the pupil became only partial when he turned with his back to the window, so as to dilate it in concert with the opposite one, and he could then see. This clot was absorbed in about a fortnight. On the other hand, when the blood is diffused through the aqueous humor, by frequent change of posture during the period when it might coagulate, it does not form a solid clot, and is more speedily absorbed, —sometimes, if in small quantity, in three days.

I imagine that the blood in such cases mixes with, and its red particles swell in, and give up their colouring matter to, the aqueous humor as they would in and to water, and that this is the occasion of their very rapid disappearance ; for a most remarkable difference is noticeable between the result of these instances, as compared with those in which blood escapes into the chambers, when they are already occupied by yellow serum, the consequence of pre-existing disease. For here the blood may remain for many months, almost entirely unchanged either in colour or quantity, just as it might do in a bottle of serum, excluded from the action of the air. The serum does not dissolve either the red particles or the coagulated fibrine ; how, then, could we expect these to be absorbed ? Nevertheless, a very slow change does go on ; some slight differences are constantly taking place between the variable serum of the blood and that occupying the chamber, owing to which, a very gradual interchange is wrought between them, and the clot becomes paler. I have watched a small clot during six months, under these circumstances, ere it lost its shape or characteristic hue.* Time does not allow me to allude to the changes in the aqueous chambers occasioned by inflammation, many of which are of the most interesting character, and most instructive to the student of pathology.

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* *See* Appendix, Case U.

I propose now to pass from the review of those parts of the eye which lie within the range of the operations usually performed on the globe, and to devote the rest of this lecture to a brief sketch of the structure of the retina; for I should be unwilling to conclude the present short course without some account, however imperfect, of that portion of the eye, which, in a physiological sense, is the most essential of all, and which will be found to be as wonderful and elaborate in structure as it is important in function.

Of the Retina.

The retina is that peripheral nervous sheet on which the images of external objects are received. It is continuous with the optic nerve, and is expanded within the globe between the choroid and vitreous humor, as far forwards as the *ora serrata*, the situation of which has been already pointed out. Its surfaces may be styled choroidal or outer, and hyaloid or inner; and by these surfaces it is organically connected, on the one hand with the choroidal epithelium, on the other with the hyaloid membrane. It has the pinkish-grey colour of the surface of the cerebral convolutions, is very soft and easily torn, and is arranged in certain layers, the inner of which contain the bloodvessels that impart the pink tint to the whole while the outer are non-vascular. All the superposed layers of the retina are thicker at the bottom of the eye, around the entrance of the optic nerve, than in front, near the ora serrata; and the entire nervous sheet becomes gradually thinner forwards, until it ends abruptly at the line indicated, being there continuous with that granular tissue which lines the ciliary processes of the choroid, and gives origin to the fibrous part of the suspensory ligament of the lens.

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* *See* Case V in the Appendix.

Constituents of the Retina.

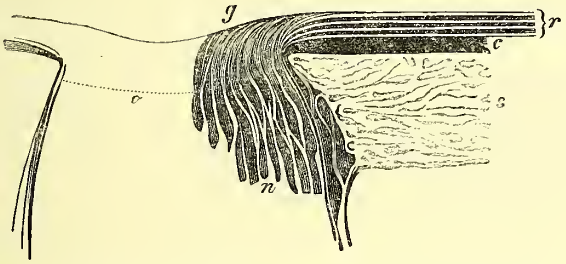
Now, the retina contains in itself all the structural elements which are to be found in other parts of the system, *except nerve-tubules*, which are not present in the human retina, nor in the retina of the higher animals, but only in the optic nerve; and it moreover contains, besides these, other structural elements not elsewhere met with, but peculiar to this part, and which we are therefore led to suspect may be in some way or other subservient to the proper action of the retina as a recipient of the vibratory impressions of light.

The *elements common to the retina with other portions of the nervous system* are placed internally, or towards the hyaloid surface. These are:—1. *Grey fibres*, radiating on all sides from the entrance of the optic nerve, towards the anterior border of the retina, and being a continuation of the nerve-tubules of the optic nerve. They are gradually less abundant forwards, terminating in succession among the next mentioned elements. 2. *Grey nervous matter, similar to the cineritious part of the cerebral convolutions* (being an amorphous, finely granular matrix, containing nucleated nerve-vesicles). 3. *Caudate nucleated globules*, analogous to those found in the ganglia, spinal cord, and certain parts of the brain. 4. *Agglomerated granules*, usually highly refractive, with very little intervening material, and allied to the nuclei of cells, such as are met with in some portions of the encephalon. Capillary bloodvessels are distributed among all but the last of these.

The *elements peculiar to the retina* are situated externally, and together form the coat commonly known as Jacob's membrane. They are of two kinds—5. *Columnar particles or rods*, arranged vertically in a single series; and 6. *Bulbous particles*, interspersed at regular intervals among the former. Both of these are found among the lower animals in many most remarkable modifications, some few of which I shall presently mention, on account of their singularity, and to show that they probably play an important part in the physiology of vision, though into the nature of their function we have as yet no particular insight. These elements, like the agglomerated granules, have no bloodvessels proper to them.

Of the Grey Fibres of the Retina.

We may now pass these several elements more distinctly in review: and first, of the grey fibres. If we make a section of the coats of the eyeball through the art at which the optic nerve traverses them to join the retina, we see that this nerve ecomes reduced in bulk as it is passing through the sclerotica, so that a transverse ection of it, where it approaches the sclerotica, has nearly double the area of its ntra-sclerotic termination, and the sclerotic canal is a truncated cone. We also bserve that whereas the nerve behind, and for a little way within, the sclerotic anal, is opaque white, the tubules having their proper investment of white substance, t becomes grey and semi-transparent ere it touches the retina, and the retina itself as never any white glistening aspect such as the nerves have. In different animals, ndeed, even among the mammalia, you will find great variety as to the precise point t which the nerve loses its whiteness, this point being sometimes only at the very unction of the nerve with the nervous expansion within; and in certain cases (of hich the Rabbit is the best example) the nerve advances a certain way within he choroid, and spreads out on the surface of the retina before it loses its whiteness, o that the retina in these animals appears to present a white area of an oval shape, nd an eighth of an inch long, at the sclerotic aperture; and in some animals yet lower in the scale, nerve-tubes, with a very delicate layer of white substance, can be traced even further, and in more uniform distribution over the retina. But still it remains true, as I believe, for all, and certainly for man, that nerve-tubules, such as form the optic nerve, do not exist as a part of the retina, and that where they enter within the sclerotica, they are to be regarded as still the optic nerve in its course to the retina.



s, Sclerotica. *c*, Choroid. *n*, Plexiform bundles of optic nerve. *o*, Line at which these lose their white substance. *g*, Grey fibres advancing to the retina, and becoming clothed on their choroidal surface with other layers, constituting *r*, the retina.

FIG. 13.—SECTION OF THE COATS OF THE HUMAN EYE AT THE ENTRANCE OF THE OPTIC NERVE, TO SHOW THE MODE OF ORIGIN OF THE LAYERS OF THE RETINA.

Now, what is the nature of the change in the constituent tubules of the optic nerve by which they lose their whiteness as they penetrate the sclerotica? They certainly do not terminate in the sclerotic canal; they cease to be characterized by their dark outline, and by their tendency to fall into the varicose or beaded state, but remain fibrous; in a word, they lose their white substance, but retain their axis or central fibre, and these fibrous parts coming together, advance and form the grey fibres of the retina. I have made many very thin sections through the nerve and retina in connexion; and you will find, if you do the same, that these fibres, on entering the globe and encountering the hyaloid, pour themselves as it were on all sides in bundles over the hyaloid surface of the retina, and become coated at once, on their opposite or choroidal surface, with the elementary structures which I have enumerated as forming the other strata of the retina.

It follows, of course, that in the space occupied by the evolution of these grey fibres from the optic nerve, *i.e.*, for the area of the inner orifice of the optic foramen or sclerotic canal, these other strata of the retina do not exist—that *the retina*, in fact, does not exist; therefore it is no wonder that this spot should be blind—insusceptible of stimulation by light. The blindness of the spot (proved by a well-known experiment), in connexion with the anatomical fact which I now point out, shows how essential to the visual power of the retina are its non-fibrous parts, so that we might almost say that the visual impression is received by the non-fibrous parts, and merely propagated by the fibrous; that the true retina is not an expansion of the optic nerve, but a nervous organ of independent structure, brought into co-operation with the brain through the nerve. But to proceed with the anatomy of the grey fibrous stratum.

In some animals (I allude particularly to some fishes) their radiation over the whole retina may be very easily made evident to anyone by a slight maceration, for the retina shaken in water becomes divested of all but these fibres, and they seem to form a brush directly continuous with the nerve.

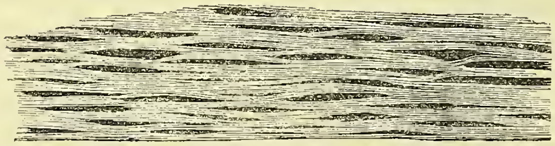


FIG. 14.—ANASTOMOSING GREY FIBRES OF HUMAN RETINA, SEEN ON THEIR HYALOID SURFACE, NEAR THE OPTIC NERVE. MAGNIFIED.

But in the higher animals it is usually more difficult to demonstrate such a disposition; both because this layer is much less readily detached from the rest, and because its fibres are disposed in bundles, which, after anastomosing together for some way, become blended with each other into a uniform lamina, and are lost among the grey nervous matter (2). In the fresh human retina they may be seen by looking directly on the inner surface, near the optic nerve, with a power of 50 diameters. (Fig. 14.)

The bundles there are large, but of different sizes, and anastomose so as to form very elongated meshes, in which large nucleated vesicles soon begin to appear. The bundles of the plexus are not cylindrical, but much compressed on their contiguous sides, so that, on a vertical section, they appear oval; otherwise this plexiform arrangement is a mere continuation of that of the bundles of tubules in the optic nerve, now spread out as a sheet, instead of being gathered up into a cylindrical cord.

Of the Central Artery and Vein.

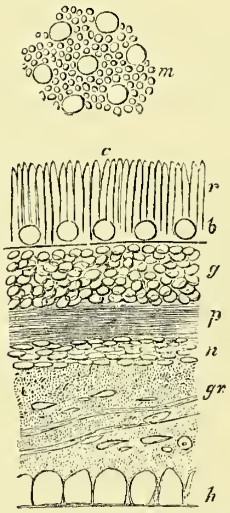
While speaking of the manner of evolution of the optic nerve at its coalition with the retina, it may be mentioned that the bloodvessels of the retina enter and leave it along the centre of the optic nerve, by two fibrous canals there provided, among the fibrous meshes in which the plexiform nerve-bundles lie. Arrived within the sclerotica, they subdivide and ramify upon the retina, the large branches which they form being, for a short way, interposed between the hyaloid and the plexiform grey fibres, but very speedily sinking in among these, and breaking up, by successive divisions, into the capillaries which supply and occupy the substance of those layers to which I have already described them to belong. Just within the *orà serràta* the plexus terminates by a marginal vessel.

2. *Of the Grey Vesicular Matter of the Retina.*—This lies contiguous to the hyaloid surface, in close relation with the last-mentioned layer. It is the most vascular coat of the retina, and, in fact, receives the greater portion of the blood brought by the retinal artery. The capillaries form a very beautiful plexus, with meshes about as close as those of the grey matter of the cerebral convolutions, though arranged nearly on one plane. The walls of the capillaries are a simple membrane, with nuclei at intervals. It is easy, at a suitable period after death, to wash out the nervous matter from their intervals, and to obtain a separate view of the whole vascular system of the retina; and in a perfectly recent specimen, also, the capillaries can be discerned among the matter of the layer now under consideration, often with the red corpuscles still within them. The finely granular matter of this layer is readily seen with a sufficient magnifying power, and also numerous nuclei; but it is not easy to discern the delicate nucleated vesicles, which it so abundantly contains; for, like those of the grey matter of the cerebral convolutions, they are very rapidly destroyed or altered by pressure or water. On some occasions they can be most distinctly seen, especially in one part to which I shall have to refer presently; and it is almost always possible enough to discover their clear globular vesicular nuclei, in a detached state, floating about the fragment examined.

3. *Of the Caudate Nucleated Vesicles.*—It is most interesting to meet with these very singular forms of nervous tissue in the retina, though we at present know little of their use. We have, now, ample proof of their being centres, from which, in many parts at least, nerve-tubules pass, the slender processes of the vesicles becoming continuous with the axes of the tubules, and acquiring, at a certain distance from their origin, a coating of white substance.

I am not aware that any one else has yet discovered this kind of vesicle in the retina. In Man, and the higher animals, it is by no means easily distinguished, for the examples of it are small, and hard to detach from the substance of the last layer, with which they are in connexion, and yet so similar in texture to that substance as not to be visible in it without separation. Nor have they here any pigment, as in so many other parts of the nervous system. That they do exist, however, is certain; for on different occasions, I have seen many unequivocal examples of them, and especially in two or three specimens of diseased retina, in which the texture was somewhat broken down by a morbid process. Among the mammalia, I have seen them in the human subject and in the Horse; but I have never witnessed so satisfactory a demonstration of them *in situ* as in the retina of the Turtle, where they lie at or near the hyaloid surface, dispersed at pretty equal distances, and with long and branching arms, which spread abroad indifferently in all directions, so widely as to approach each other near enough to anastomose together, though I have never seen them actually coalesce.

In making a vertical section of the retina in the higher animals, we very generally find an ill-defined, dark, but broken line, running parallel with the surface, in the substance of the vascular portion; and it has often occurred to me that this may be an indication of the position of a layer of these caudate vesicles intervening between the fibrous and the grey vesicular matter (1 and 2); but this explanation of the appearance requires confirmation.



r, Rods detached at the line *c* from the choroidal epithelium. *b*, bulbs. *g*, Outer layer of globular agglomerated granules. *p*, Intermediate more transparent layer, obscurely fibrous. *n*, Inner layer of flattened agglomerated granules (nummular). *gr*, Grey nervous layer, fibrous and vesicular, and containing capillary vessel. *h*, Hyaloid. *m*, Deep or inner surface of Jacob's membrane, showing rods and bulbs.

The appearances in this specimen were beautifully distinct, precisely as represented.

FIG. 15.—VERTICAL SECTION OF HUMAN RETINA (PREVIOUSLY DRIED WHEN QUITE FRESH) HALF AN INCH FROM THE ORA SERRATA. 320 DIAMETERS.

It would not be difficult to hazard conjectures as to the connexions of these caudate vesicles with the fibrous elements, and as to some special purpose they may serve in the economy of the retina; such, for example, as that of bringing into functional relation the several parts which their caudæ may connect, &c., but such conjectures can at present lead to nothing. When we come to know the general history of the caudate corpuscles in the several organs, and in the animal scale, we shall probably obtain some clearer insight into the meaning of their existence in the retina.

4. *Of the Agglomerated Granules.*—Lying externally to those already described, the agglomerated granules form a very considerable proportion of the entire thickness of the retina, viz., about one-fourth or one-third. They lie in *two layers* (fig. 15, *n* and *g*), between which intervenes a thin layer, *p*, of which I am able to give no definite account, except that it is more transparent, exhibits no globules, nor any distinct texture, though sometimes looking finely fibrous, and that it apparently contains no bloodvessels. The inner of the two layers (*n*) is always much thinner than the outer, and often consists of but two or three series of granules, which are also different in figure from the others, being flattened, with their surfaces more or less corresponding to those of the retina, and often looking much like pieces of money seen edgeways. From this fanciful resemblance, and for distinction sake, I have sometimes termed this the *nummular layer*. The outer layer (*g*), or *granular layer*, is much thicker: its constituent granules are globular, closely packed, with little sign of any surrounding cells, though a matrix, or inter-granular substance, can be seen on a broken edge. The granules cohere intimately, and when placed in water generally refract the light in a decided manner, quite different from that of the other elements of the retina. They have no bloodvessels.

Of the Peculiar Elements of the Retina.

These constitute that extremely delicate film on the exterior of the retina, first distinguished by Dr. JACOB, and since commonly called by his name. This film is in contact with the choroidal epithelium, and has a very slight organic connexion with it, which I shall presently explain. Sometimes this epithelium is partially drawn off the choroid with the retina in consequence of this adhesion; at other times, Jacob's membrane separates in part with the choroid. It can easily be washed away from the rest of the retina, its adhesion to the layer of agglomerated granules being but slight. Jacob's membrane was at one time generally regarded as a serous membrane, though not by its discoverer himself. By some it has been supposed to belong rather to the choroidal epithelium than to the retina; while HANNOVER styles it *the retina properly so called.*

Much disagreement exists with reference to the precise structure of this singular part, which is attributable in some measure to the great proneness its elements have to change after death, either with or without contact with water or various fluids. On this account, it should be examined as fresh as possible, and with every precaution. The changes it undergoes, are, however, very well worth studying in themselves, since they exhibit the peculiar properties of its elements, as tests do those of a chemical compound; and these properties may, I think, elucidate some morbid actions now most obscure. The elements may be distinguished as *rods* and *bulbs.*

Of the Rods.

These are placed perpendicularly between the granular layer and the choroidal epithelium, are in close contact with each other, except where the bulbs intervene, and their length determines the thickness of the layer. They are transparent and solid, and either cylinders or six-sided prisms: at the inner end they are attached to the granular layer, and when detached from it terminate by a square extremity; at the opposite end, they run off into a slight cone or pyramidal process, which is received into a corresponding recess in the contiguous particle of the choroidal epithelium, each particle of this pigmentary epithelium thus imbedding the pointed extremities of many of the rods. The shaft of the rod is very apt, a short time after death, to become separated by a sharp transverse line, from the pointed process or leg, and the leg will then gather itself into a ball and disintegrate, while the shaft will bend into a hook at the outer end, or roll into a globule, or split up into transverse plates, or be reduced to a shapeless granular mass. These changes are assisted by immersion in water.

These points in the anatomy of the rods could, with difficulty, have been made out in the human retina, without the indications of structure provided in the corresponding parts of the lower vertebrata, where they are developed to a much greater size. **Hannover** has given a very admirable description of them in the vertebrate class, in all the great divisions of which they are constantly present; being very large in some fishes, especially the Pike, and in batrachian reptiles.

From a careful examination of a perfectly recent human eye, I ascertained that the rods were longest, and consequently Jacob's membrane thickest, at the hinder part of the globe, and that anteriorly, close to the ora serrata, they gradually shortened by more than a half, still retaining their general characteristics.

Of the Bulbs.

These, in the human retina, are very much less numerous than the rods, among which they are scattered at even distances. On looking at the outer surface of Jacob's membrane with a sufficient power (fig. 15, *m*), we see an infinite number of minute globules (the ends of the rods), and among these, but at a deeper level, *i.e.*, not coming quite up to the outer surface, solitary, larger, transparent, rounded objects, which are the bulbs. When fortunate enough to obtain a view of the whole layer in section, cut or torn across, we see the bulbs sessile upon the layer of agglomerated granules, and distributed, at their proper intervals, among the rods, where these rest upon the granules. They appear to be globular or egg-shaped, and sometimes to have a small blunt spur upon them, turned towards the choroid. When looking down upon the choroidal surface of the retina, the bulbs, when best seen, have a small clear circle within their proper outline, and this seems referable to this projecting part.

Some light is thrown upon the nature of these bulbs by what seems to be a very large development of them in fishes, and here they present themselves in a very remarkable form, and with no less remarkable properties, as HANNOVER has well portrayed.* They are divisible into legs and a body, of about equal length; the body directed inwards—the legs outwards; the body implanted vertically among the rods—the legs tapering in the opposite direction, and imbedded among the pyramidal processes of the rods, and, in a similar manner, within sheaths furnished by fibrous prolongations of the particles of the choroidal epithelium. The body is thicker than the legs, and has an oval or circular section. It is also partially subdivided into two lobes: it has a distinct membranous covering, enclosing a colourless, transparent, highly refracting material, which soon changes after death. The legs are also double, one descending from each lobe and tapering to a point; and where they join the body there is a transverse line of division, at which they readily break off. When placed in water, the body swells and shortens, assuming the form of a somewhat flattened balloon, which retains the bilobate form, and sometimes looks not unlike a coffee berry. The investing membrane readily gives way; the clear contents become coarsely granular, and may break up into irregular masses, or disintegrate. By the same medium there is occasioned first a transparent line of division between the body and legs, and then the legs curl up at the end, or split into many transverse pieces, having a high refracting power.

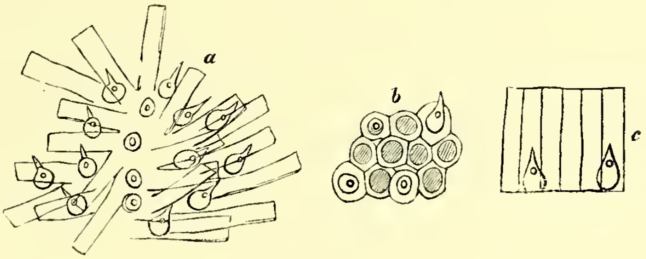


FIG. 16.

a, Bulbs and rods of Jacob's membrane in the Frog, looking on the outer surface, the choroidal epithelium being removed. The rods are thrown down in various directions, so as to expose the bulbs among them at their base. The bulbs have a spur and pellucid globule. *b*, A similar view, but where the rods are upright, and not displaced; their base, with the bulbs, being brought into focus. The outer ends of the rods are out of focus, and appear dark shades in the centres. *c*, Same in vertical section.

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* 'Recherches microscopiques sur le système nerveux,' 1844, pl. iv.

Hannover supposes that these bodies (which he terms *cônes jumeaux*) do not exist in reptiles (except chelonian). I have, however, met with objects which appear very similar to the bulbs of the human retina in the Frog. Examining it quite fresh, under albumen, we find the appearances represented in fig. 16. The bulbs seem nearly as numerous as the rods, among which they lie: they rest upon their proper base, are globular, with a projecting process, ascending towards the choroidal epithelium, and, near the root of this process or leg, contain a minute colourless oil-globule.

This leads me to a very interesting point in the structure of both rods and bulbs in many animals, viz., the occurrence, in their outer or choroidal ends, of globules resembling oil, either colourless or possessing most brilliant tints of yellow or crimson. In the chelonian reptiles, and in birds, these are the most beautiful. I shall show you, after lecture, the outer aspect of a portion of the retina of the Tortoise, in which you will perceive a most elegant array of pale, of yellow, and of crimson globules, scattered with regularity over the surface, the first being the smallest, and the last the largest, but all enclosed within the substance of the particles now described. It is not satisfactorily made out what is the precise relation of these globules to the rods and bulbs respectively, partly because the distinction between these elements in these animals is not fully determined; but **Hannover** considers the crimson globules to belong to the bulbs or *cones*, and all to be properly not globular, but of the nature of sheaths to the particles where inserted into the choroidal epithelium.

In birds we have even a more beautiful pattern of colours. In the Sturgeon, among fishes, I have found the globules large, but colourless. In mammalia they are either very small, or wanting.

Of the Yellow Spot of the Retina, or Spot of Soemmerring.

If we cut across a fresh human eye, so as to look at the hyaloid surface of the retina, or if we carefully remove the sclerotic and choroid coats, so as to expose to view its choroidal aspect, we are struck with the rich yellow colour of one small spot about one-twelfth of an inch in diameter, situated at the very bottom of the eye, in the exact axis of the humors, *i.e.*, at about one-tenth of an inch from the optic nerve. The colour is deepest in the young adult, much fainter in the old. It exists in some Monkeys, and, according to Dr. **Knox**, in certain reptiles, but in general it is wanting among the lower animals, while it is quite constant in Man. The colour shades gradually off, and is deepest when seen from the inside. Very commonly the retina exhibits at this spot a small fold or wrinkle, often two or three folds meeting in the centre, but sometimes none; and I have myself found that the more recent the eye, and the more careful the manipulations employed, the less tendency there has been to the appearance of the fold; while in the instances in which it has been present, it has been always possible to obliterate it by delicate traction in the requisite direction. I am therefore disposed to regard this fold as a false appearance. All who are accustomed to dissect this organ are aware with how much facility any part of the retina is thrown into folds by slight violence done to the vitreous humor in exposing the inside of the eye, owing principally to the extremely feeble union existing between the retina and the choroidal epithelium. We have already seen, too, how readily the elements of Jacob's membrane absorb water. Now it appears to me that the texture of the retina at the yellow spot allows of a freer post-mortem transmission of the water of the vitreous humor through to Jacob's membrane than at other parts; and, consequently, that this part of the retina is earlier loosened from the choroid, and rendered liable to be thrown into accidental folds, than the rest; and in this way I account for the plicæ at the yellow spot, which some anatomists have regarded as a natural condition.

On removing the sclerotica and choroid with care from the back of an eye, so as to expose the outside of the retina, the yellow spot seems more transparent than the rest of the nervous sheet; no fold appears, but in its centre a minute dot, which seems like a circular hole, through which we can look into the vitreous humor. I have on some occasions seen this hole so distinctly, and with so definite a margin, that it seems impossible to deny its reality; but whether it occupies the whole thickness of the retina, being a deficiency in all the layers, I am unable positively to say. I have in one instance deemed it wanting in Jacob's membrane, which wore the appearance of passing uninterruptedly over it; but the difficulty of bringing the part under examination by sufficiently high powers, without mutilation or disturbance, and without swelling of the parts from imbibition, is such, that I would not speak too confidently on this point.* The adhesion of the hyaloid to the retina is more intimate than that of the choroid to the same part; and, therefore, it is even more difficult to examine the hyaloid surface of the yellow spot with high magnifying powers, without disturbance of it, than the choroidal; for if the vitreous be detached from over the yellow spot, some derangement of it is sure to occur: and to cut through the vitreous, so as to leave a thin film of it *in situ* upon the yellow spot, is a very nice matter. When this is satisfactorily done, we observe the border of the spot to rise into a gentle eminence, so that its middle part projects a little towards the vitreous humor; and in its centre is an oval or slit-like hollow, formed by the hyaloid surface dipping on all sides from the hyaloid, and the opposite sides coming into contact, the vitreous not entering the hollow. Thus the surface of the retina at the yellow spot appears to present a slanting surface to the rays of light.

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* I had lately an opportunity of examining the yellow spot in the recent eye of a Monkey, and found a space in the centre of the spot, about the size of a small pin's head, almost perfectly transparent, contrasting strongly with the surrounding nervous matter, which was but slightly yellow for a short space from this apparent hole. The nervous elements could not be seen over this transparent part, but only a membrane with a few granules and nuclei, as though the several layers had been atrophied there, leaving only a residual web, continuous with the borders of the circumambient yellow matter, and separating the choroidal epithelium from the hyaloid.

I would also refer to a notice of a preparation of this region in a human fœtal eye, in the paper on the vitreous body, *infra*, p. 187.

Modification of the Retinal Layers at the Yellow Spot.

The texture of the several layers at the yellow spot is much modified. In particular, the grey fibres do not pass over it in a direct course from the optic nerve to the side of the retina beyond the spot, but take a circuitous course, so as to avoid the spot, and only that small number approach the spot which properly belong to it, and terminate in it. In this respect it differs from the rest of the deeper portion of the retina, and must be regarded as more perfectly organized. In the same way, as is well known, this portion of the retina, though so near the main vessels, is not encumbered by any of the large branches, but the branches which supply the spot and the regions beyond it arch above and below it at such a distance as not to interfere with its perfection, and the spot itself has only capillaries, which communicate with the arterial and venous twigs on all sides. This arrangement of the blood-vessels occurs also in animals which have no yellow spot.

The plexiform fasciculi of grey fibres approaching the spot have nucleated vesicles of large size interposed in the meshes; and as the fibres gradually lose themselves from view, these vesicles increase in number so as at length to occupy the whole surface. It is possible to see the fibres reduced to smaller and smaller bundles, and become mingled with the vesicles; but I have never been able to distinguish any special relation subsisting between the individual fibres and the vesicular elements. The nucleated vesicles of which I now speak are not exactly like those met with in the retina generally; and whether they are a modification of those of the layer (2) or of the caudate vesicles, I cannot say; for at the yellow spot the inner layers are less distinguishable from one another than elsewhere: on a vertical section they are more confused, and present, in common, a rather obscure, dark, yellow aspect. I am inclined to believe, however, that the vesicular nervous matter (2) is here in a high state of development, the vesicles being very numerous, and of more stable constitution than elsewhere. The layer, which I suggested (p. 175) might be that of the caudate corpuscles, appears to be considerably thicker, and to blend with the vesicular on the surface of the yellow spot. The layers of the agglomerated granules pass into the yellow spot, the granular layer *g*, being thinner, the nummular, *n*, thicker than elsewhere. The two elements of Jacob's membrane are found over the yellow spot as on the surrounding parts of the retina; the rods are of the same length, but thicker, and the bulb-like bodies are nearer together.

The colour of the spot does not appear to be confined to any single texture, but appears to bathe all the textures, except those of Jacob's membrane, in a common cloud of rich yellow, deepening towards the centre. The colour is here and there in minute grains of deeper hue; but in general it does not seem to lie in proper pigment cells. but to stain fibres, vesicles, and granules alike. The colour soon disappears after death, or in water. I recently, however, left a retina in water for a fortnight, and still found it retaining some of its original hue at this spot: in the dried retina it is permanently retained.

Such, gentlemen, is a brief account of the retina as I have found it in numerous examinations in Man and animals during the last four or five years. If you take the trouble to compare it with the accounts which have been published, you will find it to correspond in most points with the most recent descriptions furnished by HANNOVER, PACINI, and others, but to differ from all in a few particulars. It has not been my object to discuss disputed points, but to combine in one view what seemed most consistent with the truth of nature. I would venture earnestly to advise those of you who have the opportunity, to examine this elaborate structure for yourselves, as it contains within a small compass a most admirable and orderly arrangement of parts, some having the common characters of nervous elements, but others of so singular an aspect and properties, as to present questions of great interest, upon which a more extended study may be expected to throw much light.

OBSERVATIONS ON THE STRUCTURE OF THE VITREOUS HUMOR.

(*Reprinted from ‘The Dublin Quarterly Journal of Medical Science’ of August*, 1848.)

During the last few years considerable attention has been given in Germany to the anatomical structure of the vitreous body. This part has been hitherto loosely held to consist of an extremely delicate filamentous tissue, so interlaced as to enclose cellular spaces, in which the water was supposed to be retained, which slowly escaped when the hyaloid investment was punctured. Not that any anatomist had seen these filaments or cells, but their existence was deduced from the fragmentary form taken by the contained water when frozen, particularly as it afforded a plausible explanation of the more obvious properties of the structure, by a fancied analogy with common areolar tissue. When, however, more perfect means of investigation came to be applied without success to the detection of the filamentary substratum, there was room for new researches of a different kind, with a view to the discovery of some other structural cause of the curious and very peculiar physical properties exhibited by the fresh and healthy vitreous body. Pappenheim appears to have been the first to call attention to the fact that evidence may be obtained of an internal artificial arrangement of parts. He announced that the vitreous body, treated with a solution of carbonate of potass, exhibited a succession of concentric layers, something like those of an onion.* Brücke, in the following year,† pursued this hint, imagining that there might exist in the substance of the vitreous body a series of membranes capable of anatomical demonstration; and he thought it probable that, by steeping the humor in a solution which would furnish a precipitate as it permeated the vitreous substance, these membranes might arrest the precipitate, and thus become apparent to the eye. He accordingly exposed the surface of the vitreous in a Sheep's eye, by removing the sclerotic, choroid, and retina, about as far forward as the ora serrata, and placed it in a concentrated solution of acetate of lead. The surface became immediately covered with a white crust, and when, after some hours, he cut a small slice from the hinder region, he found the cut surface marked with fine milk-white lines, running parallel to the original surface, and presenting throughout the appearance of a finely striped agate. He soon satisfied himself that these stripes proceeded from milk-white layers traversing the vitreous substance in suchwise that the outermost was almost parallel to the retina or hyaloid, and the innermost to the back of the crystalline lens; the intervals being consequently greatest in the axis of the eye, and least towards the zone of Zinn (suspensory ligament). Here the outer layers were closely approximated, and terminated by uniting with that portion of the hyaloid which lies against the zone; but as respects the middle and inner layers, he was unable to satisfy himself how they ended. Proceeding onwards, he examined the texture of these layers. With the naked eye or an ordinary lens they appeared simply to consist of a milky, transparent membrane, but with a higher magnifying power a fine granular precipitate (probably chloride of lead) became visible in the position of the white lines, and in their intervals either a perfectly transparent space, or else a smaller quantity of a more delicate and similar granular deposit. **Brücke** further observed that the vitreous body thus prepared tore most easily in the direction of these layers; and he noticed that the transparent spaces between the white layers were occupied by an apparently gelatinous mass, similar in constitution to the rest, and were not free spaces containing fluid. He offered no explanation why the aqueous fluid of the vitreous escapes so readily on a puncture which, he rightly remarks, never happens from a true jelly.

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* ‘Specielle Geweblehre des Auges,’ Breslau, 1842, s. 182.

† ‘Müller's Archiv.,’ 1843, s. 346.

In a subsequent communication* the same anatomist observes, that the frozen vitreous body, far from affording ground for the idea of a cellular constitution, in reality accords with, and even favours, that which he had previously advocated—viz., that the vitreous body is made up of concentric membranes, enclosed one with another. He states that if a well-frozen eye be brought into a warm room, so as to thaw the tunics investing the vitreous, and if these be then carefully removed, the frozen vitreous body appears as a coherent mass of ice, from the surface of which minute flakes may be detached with the point of a scalpel, as the external warmth gradually acts upon it. These flakes he has traced to near the lens, and as they seem to him to have the same direction as those exhibited by the aid of the metallic salt, he concludes that they are the result of the same membranous stratification which he had before demonstrated.

Another distinguished physiologist has also devoted a paper to this interesting subject.† He made his observations on the eyes of mammalia, after immersing them for at least six months in a solution of chromic acid. He describes somewhat more particularly the concentric layers which had been noticed by the previous authors, and states that if the eye be divided by a median transverse section the appearance is that of an onion similarly cut; and this he finds in the Cat, Dog, Ox, and Sheep. But in *Man* he says that a different structure obtains, rudely comparable to that

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* 'Müller's Archiv.,' 1845, s. 130.

† Hannover, "Entdeckung des Baues des Glaskörper's," 'Müller's Archiv.,' 1845.

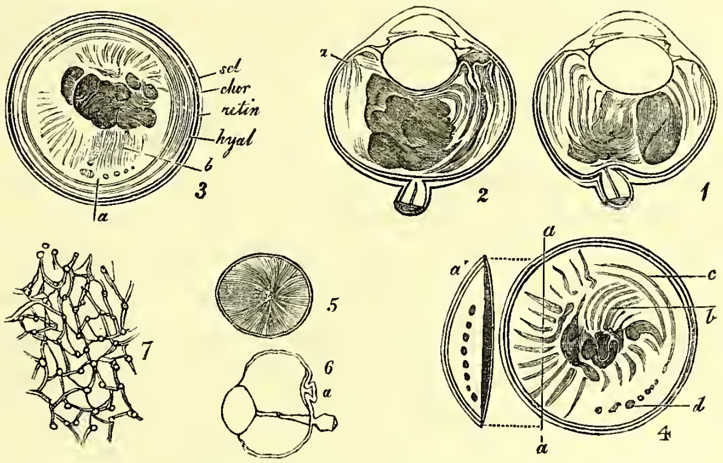
of an orange, there being segments, of which the convexities are turned outwards, while the angles converge towards, but do not reach, the axis of the eye, where the hyaloid canal exists in infants. In two specimens **Hannover** was able to count 180 rays, and he therefore concludes upon that number of segments: he was unable to ascertain whether each segment had its proper containing membrane, or whether a single membrane was common to two contiguous segments. Examined with the microscope, he finds the walls of the segments to present the aspect of transparent membrane without structure, covered with numberless granules, which he thinks are probably the result of a precipitation. He concludes with an account of the exact arrangement of the parts about the zone of Zinn, into which it is unnecessary here to follow him.

As I am not aware that these researches have been at all prosecuted as yet by any anatomist in this country, and as it seems probable from my own investigations that much difference of opinion is likely to exist with regard to the true interpretation of the appearances which have been above briefly described, I am desirous to communicate in a simple form the result of my own observations on the vitreous humor of Man and other mammalia, and of birds and fishes. In doing so, I am very sensible how much is still wanted to render them complete.

Action of Chromic Acid on the Human Vitreous Body.

Having more than a year ago placed several *human* eyes, as fresh as possible (*i.e.* within twenty-four hours after death), and which had been removed from the orbits with special care, to avoid compression of the humors, in dilute solution of chromic acid (the strength indicated by a light straw colour), I soon found them to have become distended and tense, and the outer coat hardened, and I recently made sections of them in various directions, with a very sharp knife, taking care in making the sections that the globes were not squeezed or cut unevenly. The best marked examples are delineated in figs. 1 to 7.

The vitreous body in all was rendered semi-opaque throughout, but the opacity was more obvious and decided in some directions. Most of the sections dividing the eye into an anterior and posterior half (figs. 3, 4) exhibited faint lines of greater opacity, parallel to the retina, running partly or altogether round the section. These lines were more opaque when the observer looked at them in certain directions, and with a little care it was easy to see that they were the edges of opaque lamellæ which followed the curvature of the retina. In no case did these circular lines extend more than about one-third of the way from the retina to the centre of the vitreous, and when they ceased they were replaced by others of a straight or slightly waved character, which had more or less of a convergent direction towards the centre. In the centre, in



SECTIONS OF THE HUMAN VITREOUS BODY, MADE AFTER BEING IMMERSED FOR UPWARDS OF A YEAR IN WEAK SOLUTION OF CHROMIC ACID.

Immersion commenced within twenty-four hours after death, and every care being taken to avoid injury.

FIG. 1.—HORIZONTAL SECTION OF THE GLOBE.

The dark lines in the figure indicate the situation of the white lines in the preparation; in the centre is an irregular cavity.

FIG. 2.—VERTICAL ANTERO-POSTERIOR SECTION OF THE GLOBE.

a, White lines running up to the hyaloid at the ora serrata.

FIG. 3.—VERTICAL TRANSVERSE SECTION OF THE GLOBE.

Anterior half seen from behind. Within the hyaloid, concentric light and dark lines are seen; within these, at *a*, are several dark dots, which are tubular spaces cut across, which dip inwards and approach the central irregular cavity in a curved course. The radiating lines, *b*, are dark in the preparation, and the substance is not interrupted where they occur, as far as I could ascertain.

FIG. 4.—SIMILAR SECTION FROM ANOTHER EYE.

Posterior half seen from the front. In this figure the shaded parts indicate the darker parts of the preparation; in the centre is an irregular cavity; from this, or its vicinity, radiate many lines, most of which are tubular, as I proved by subsequently carrying a second section, *á*, through *a a*. The cause of what a geologist would call the unconformable arrangement of the lines at *b*, I cannot account for: the knife evidently has not produced them. At *c* is a dark line, the cut edge of a layer of the vitreous which has not been whitened like the rest, and which is concentric with the retina; tracing this towards *d* we come to a number of tubes cut across, dipping inwards in a continuation of the same plane.

FIG. 5.—VERTICAL TRANSVERSE SECTION OF THE VITREOUS HUMOR OF A NINE MONTHS HUMAN FŒTUS,

After immersion for a year in a dilute solution of chromic acid. The hyaloid canal is seen near the centre; and a very obvious radiation of somewhat curved lines from the wall of that canal; the texture was apt to tear in the direction of these lines.

FIG. 6.—HORIZONTAL SECTION OF THE RETINA, VITREOUS HUMOR, AND LENS OF A NINE MONTHS FŒTAL EYE,

Similarly treated. The section is carried through the optic nerve, spot of Soemmerring, hyaloid canal, and lens; the vitreous humor exhibited an uniform opacity in this section. The spot of Soemmerring is represented at *a*, where the retina is seen to recede from the vitreous body, and form a follicular pouch with a narrow neck, over which the hyaloid passes without entering; the hyaloid canal has been cut open in its hinder half, while the anterior portion remains tubular on the very surface of the preparation. No stem from the extremity of the optic nerve entering the canal can be distinguished in the actual specimen.

FIG. 7.—FRAGMENT OF THE VITREOUS SUBSTANCE OF THE SAME EYE, seen under a power of 300 diameters.

all the specimens, was an irregular cavity of variable size, apparently formed by breaking up of the tissue. In some specimens, where the circular lines were deficient, more transparent lines, of from $\frac{1}{20}$th to $\frac{1}{80}$th of an inch wide, traversed the otherwise homogeneous substance, from the central cavity or its vicinity towards, or even up to, the hyaloid. These were straight or slightly curved, and of unequal width, and were proved to be tubular channels by cutting them across, when their orifices became clearly visible. In one specimen there were nearly twenty of these near the surface of the section, and in all probability many more too deep for view. Other tubular spaces were seen in one case (fig. 4, *d*) passing in the curve of the concentric layers.

In the sections carried through the optic nerve and lens, and dividing the eye into an upper and lower, or into two lateral halves (figs. 1, 2), a few lines of greater opacity were seen, preserving a more or less exact parallelism with the cut edge of the retina, and obviously the edges of laminæ more opaque than the rest. A very slight touch with a pin sufficed to tear the vitreous in the direction of these lines, and to convert the laminæ into separate sheets, and this has been done to a slight extent in one of the specimens figured. (Fig. 2.) In these specimens the broken central cavity comes so near the optic nerve that the layers are hardly to be seen there, but in front their disposition is not doubtful. Several, and those the outer ones, run towards the ciliary body, and there seem to approach the very surface of the vitreous near the ora serrata, probably uniting with the hyaloid in contact with the zone of Zinn, as described by Brücke. Then those next within bend inwards towards the margin and back of the lens, of course behind the canal of Petit, and they appear rather to cease in succession at the surface of the lens than to be continued concentrically behind it, though on this point the preparations do not speak positively. Between the layers that pass towards the ora serrata and those inclining to the lens the texture seems less coherent, for in some of the specimens the central cavity has spread here and there in this direction, so as even to reach the ciliary processes and expose them to view from behind when the cavity is laid open by a vertical transverse incision.

Viewed with a high power these specimens exhibit no special texture; nothing but a finely granular mass appears, which is merely rather darker and more obscure where the naked eye detects the opaque lines. No definite streak bounds the light and dark spaces; there is no evidence of a true membrane discoverable by the microscope within the hyaloid: as far as we can see, the light and dark layers have the same amorphous structure.

Structure of the Vitreous Humor in the Fœtus.

Among human eyes were those of a still-born fœtus. The vertical transverse section of one of them is represented in fig. 5, to the description of which the reader is referred. It seems to accord with the observations of Hannover. No vestige of layers concentric with the retina was to be found in this or the other eye. The other was cut horizontally, and the knife, fortunately, passed through the optic nerve, spot of Soemmerring, and hyaloid canal, so as to show all these at once. The description of fig. 6 contains what was observed on this section. That there was no streakiness, no radiating lines in this section, is favourable (taken in conjunction with the appearance of the other section) to HANNOVER's view of segments or their plates radiating from the central axis. If they really exist, they would probably be invisible in the horizontal section, or in any antero-posterior section running along the axis, because they would be then seen flatwise, whereas they would be presented edgewise in a transverse section.

With a power of 300 diameters these specimens of the vitreous show a very well marked but peculiar fibrous texture (fig. 7), not at all unlike that of the enamel pulp described by Dr. TODD and myself.* The fibres join in numerous points, at which are minute nuclear granules, resembling oil-particles, but not soluble in ether.

Action of the Diacetate of Lead on the Vitreous Body.

Having repeated the experiments of BRÜCKE by immersing the vitreous body of several animals in a strong solution of diacetate of lead, I am enabled to corroborate the accuracy of his descriptions, though not the deductions he has drawn from the phenomena observed. I followed his directions by removing from the fresh eyes of the Sheep, Lamb, and Ox, the sclerotica, choroid, and retina, as far forwards as the ora serrata, using the utmost care to avoid rupture or injury of any kind to the vitreous body: the eyes were then placed in the metallic solution. The hyaloid surface immediately became milky, from precipitation of the lead, and in the course of a short time it was of a dead white, and the vitreous humor began gradually to diminish in size. Some of the specimens were cut into after a few hours' immersion, while others were allowed to remain forty-eight hours in the solution. The time elapsing before the sections were made had no influence on the changes wrought within, except as regards the depth to which they had reached, and the result may therefore be given in a few words. However the vitreous was cut into, white lines were seen on the cut surface, parallel to the exterior; these lines were, therefore, the divided edges of white layers concentric with that surface. (Figs. 8 to 10.)

In exact accordance with BRÜCKE's account, I found the white lines in the hinder and lateral parts more intense, further asunder, and fewer in number, than in the region of the ciliary body, where they were very fine, delicate, and closely arranged, so as hardly to be visible without the aid of a pocket glass. (*See* fig. 8.) The difficulty of making a clean section at this part, even with a sharp knife, in consequence of the tendency of the structure to be drawn before the blade, caused some uncertainty with regard to the ultimate destination of these lines in the ciliary region. However, after examination of many specimens, I was enabled to feel assured that they passed up to the hyaloid at or in front of the ora serrata, and did not pass round at the back of the lens, in parallelism with the anterior surface of the vitreous body. This being the general arrangement, I noticed in some specimens, of which fig. 9 was the best marked, white layers of irregular character behind the lens at *c*, and others obviously dipping backwards from the side of the lens, behind the canal of Petit, into the central portion of the vitreous, and there breaking up into fine layers, *d*. Others, again, followed the posterior wall of the canal of Petit from the ciliary body to the lens. It will be observed that the layer marked *d* corresponds nearly in direction with those which diverge from the ciliary body, and run up to the lens in figs. 1 and 2 from the human eye. In one section through the close and fine lines near the ora serrata I found the appearance delineated in fig. 10, where the lines *c* are inclined at an angle to those at *b*. In the specimens thus prepared there was usually a disposition to tear in the direction of the white lines, especially behind, where the lines were more opaque and wider apart.

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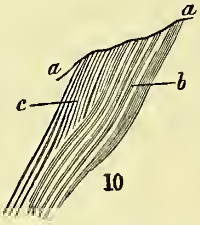
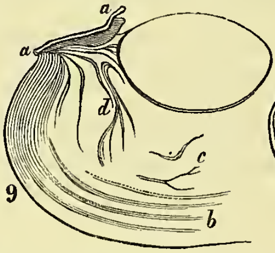
* 'Physiological Anatomy,' vol. ii, p. 175.





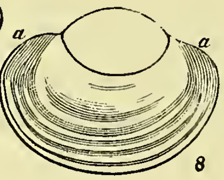


FIG. 8.—THE VITREOUS AND LENS CUT THROUGH THEIR CENTRES IN THE EYE OF A LAMB,

Which had been steeped for five hours in a solution of diacetate of lead, after the tunics had been removed from the hyaloid as far forward as the ora serrata. At *a a* the lines are very fine and close, and should be fifteen or twenty in number, and only visible with a lens. The ciliary body is not represented.

FIG. 9.—EYE OF AN OX.

Tunics removed so as to expose the hyaloid as far forwards as the ora serrata, then immersed in solution of diacetate of lead for forty-eight hours, and cut with a very sharp knife through the centre. *a a*, Ciliary body in section. At *b*, the dense white lines are thick and wide apart. At *c*, are indications of irregular layers of precipitate. At *d*, is a white lamella passing from near the lens, and subdividing in the substance of the vitreous body. Very close and fine lines run from the hinder part of the ciliary body, or rather from the hyaloid, towards the coarse lines behind; others approach the lens behind the canal of Petit.

FIG. 10.—FROM THE SHEEP.

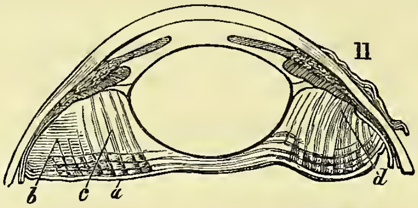
Prepared as fig. 9, drawn on a magnified scale. The fine lines of precipitate in the vitreous opposite the ciliary body. *a a*, Hyaloid in contact with the ciliary body. *b*, Light and dark lines, each $\frac{1}{600}$th of an inch wide. *c*, Still finer lines, which in this specimen were not parallel to those at *b*.

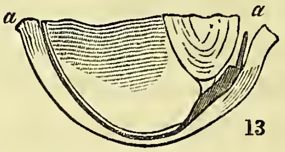
There can be no doubt that the white layers now described are composed of a precipitate of the lead. Examined with a high power the grains of precipitate are obvious enough. They are scattered irregularly in the transparent tissue of the vitreous wherever the solution has penetrated, but in the white layers they are infinitely more abundant. Still no sudden bounding line can be distinguished which would warrant the belief that any membrane like the basement membrane of other parts had intercepted the precipitate. In some parts the grains of the precipitate had arranged themselves on the surface of the more opaque layers in something of an areolar form.

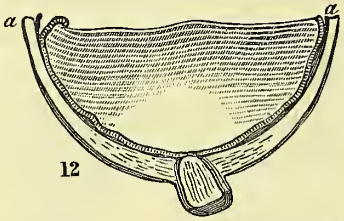
It is easy to understand how an accumulation of a multitude of precipitated particles in a certain plane would, so far as their presence extended, serve to break up the continuity and strength of the vitreous substance in that direction; therefore the splitting or tearing of the tissue along such lines adds nothing to the evidence afforded by the simple deposit of the precipitate for the existence of real lamellæ in the original tissue.

Feeling uncertain whether the layers of precipitate thus parallel to the surface exposed to the salt might not be due to some purely physical cause, I procured some perfectly fresh eyes of Oxen and Sheep, and, before immersing them in the solution of the diacetate of lead, divided them right across with a very sharp instrument, with the greatest care to avoid dragging, or disturbing the texture of the vitreous humor. Some were divided horizontally, and others into an anterior and posterior half. The halves were then placed in the diacetate for forty-eight hours, some with the vitreous upwards, others downwards. When examined at the end of that time, the cut surface of the vitreous, which had been in contact with the salt, was of a dense white, like that of the uncut surface in the former experiments, and on making an incision into it, white lines were found running parallel with it, just as they had been found running parallel with the uncut surface. To make this more apparent I have added some figures. (Figs. 11 to 14.)

The descriptions appended to these figures will explain the points they are intended to illustrate. The conclusion they lead to is this: that the very beautiful and very elegant layers produced in the vitreous substance by immersion in the salt of lead do not depend on any corresponding series of anatomical membranes, but are due to a physical cause, which will probably be explained more easily by the physico-chemical inquirer than by the anatomist. At first sight, indeed, they seem not to admit of explanation by any of the known laws of imbibition and transmission of fluids through porous substances; and some of my friends well versed in those laws were not able to offer even a probable explanation, when I showed them the preparations. The difference in the closeness of the layers in the hinder region of the vitreous, and in front near the ciliary body, may depend on some real difference in regard to closeness, or compactnesss, or permeability, or chemical constitution of the vitreous substance in the two situations. Or it may possibly depend on the different access of the solution to the two parts. But however such variations may be explicable, they are proved, I think, by the last-cited experiments, not to depend on any difference in the number or thickness of actual membranes in the two situations. The fine, close lines in figs. 8 and 9, and the equally fine ones in the same region of fig. 11, *b*, traverse







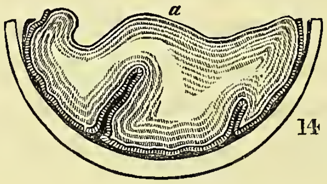


FIG. 11.—FROM THE OX.

This eye was cut vertically into an anterior and posterior half. The anterior half, having lain forty-eight hours in diacetate of lead solution, was divided so as to show the surface delineated. *a*, The line of section previous to the immersion in salt—parallel to this are several lines of white precipitate, coarse and far apart. *b*, Other lines of precipitate, also parallel to the surface which has been exposed to the fluid, but finer and closer. *c*, Dense lines of precipitate, taking a different direction, and crossing the others. *d*, Similar lines, which seem to run up to the ciliary body, and to be attached there; all the lines indicate cut edges of lamellæ of precipitate.

FIG. 12.—THE EYE OF AN OX,

Cut into an anterior and posterior half, and the latter then immersed in diacetate of lead for forty-eight hours, and afterwards cut horizontally through the optic nerve, exposing the surface depicted. The knife has passed through many successive planes of precipitate, parallel to the cut surface, *a a*, which has been in contact with the salt.

FIG. 13.—FROM THE SHEEP.

This eye was cut through vertically from front to back, and the halves separately immersed in solution of diacetate of lead for forty-eight hours; a new section of the outer half was now made horizontally, dividing it into quarters; one of the new surfaces thus exposed is here represented, *a a* being the line of the first cut previous to immersion; the vitreous exhibits numerous fine and close lines, which are the cut edges of layers of precipitate, parallel to the surface which has been in contact with the salt; they gradually diminish in distinctness inwards.

FIG. 14.—THE POSTERIOR HALF WAS CUT FROM THE EYE OF AN OX AND IMMERSED IN DIACETATE OF LEAD FOR FORTY-EIGHT HOURS.

The cut surface of the vitreous humor, when whitened by the salt, was seen to be very irregular, as if it had been dragged in making the section; when the specimen was divided again through the centre, so as to expose the surface delineated, the retina was seen thrown into deep folds, obviously in making the former cut; the lines of precipitate were parallel to the retina thus folded, and also to the irregular surface *a*, which had been made by the original cut. By the loosening of the retina from the choroid in the specimen, the fluid had probably found its way nearly equally to the whole surface of the vitreous mass immersed in it.

the vitreous substance in directions too dissimilar for us to imagine them to be the exponents of an anatomical lamination; but they are in both cases parallel to the surface previously exposed to the salt.

The Frozen Vitreous Humor.

In his later paper, Brücke draws an argument for the existence of the concentric layers as a true structure from the condition of the vitreous when frozen; but in this I confess he appears to me to have been warped by the idea previously in his mind He says that when the thawing of the frozen mass commences, thin flakes of ice may be picked off from the surface, as though the ice had taken the form of the concentric lamellæ while freezing. For my own part I have been unsuccessful in finding any indication of the concentric flakes in this way. The ice appears to shoot in the substance of the vitreous in a crystalline form, quite irrespective of any structure existing there, and as it melts, layers and angular fragments may be got off it in a variety of directions. I feel sure that the ice never takes the figure of the cup-shaped lamellæ supposed.

Vitreous Humor of the Bird.

I have examined the vitreous humor of the eye of the common fowl after a month's immersion in the solution of chromic acid. After this period of immersion, short as compared with that recommended by Hannover, the vitreous—as shown in the annexed woodcut, fig. 15—was found throughout rendered slightly opaque; no concentric lamellæ or layers, in any respect parallel to each other, were discovered; but a very evident arrangement of more opaque fibres was seen extending chiefly from the summit of the pecten towards the ora serrata, and a few towards the lens, while

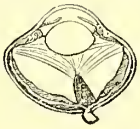


FIG. 15.—FRESH EYE OF A COMMON FOWL.

Immersed during three weeks in dilute solution of chromic acid; section carried obliquely through, and parallel to, the plates of the pecten; striæ are seen proceeding from the summit of the pecten, chiefly towards the ciliary body, but also towards the lens; others appear to pass from the ciliary body towards the lens.

others stretched from the ciliary body to the side of the lens. On attempting to break down the vitreous substance it tore by preference along these fibres, so as to leave them dissected and isolated, and they manifested a certain elasticity. The sides of the pecten also appeared to give off a few fibres, but only in one or two situations. In the bird's eye I found that the vitreous had always undergone partial collapse, and so become separated from the retina during the immersion in the solution. It still, however, adhered to the surface of the pecten, and to the ciliary body and lens. A thin exterior layer of the lens was hard and opaque, while all within retained its perfectly fresh characters.

Vitreous Humor in Fishes.

I also placed several eyes of fishes in the same solution of chromic acid, some entire, others with the cornea carefully removed, in order to permit a freer and readier access of the acid to the vitreous substance. In the former, I found, after a month, that the interior parts had not been reached by the acid, and that they were destroyed by decomposition. In the others, all the textures were preserved, and in making a section in the axis the following appearances were observed in the vitreous humor. It passed in layers from the region of the ora serrata to the side and back of the lens. The layers diverged to reach their several destinations, and here and there open spaces between them were cut through, which, though, possibly the result

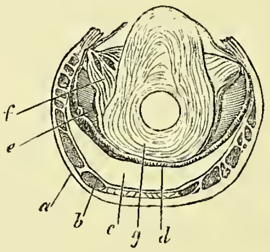


FIG. 16.—EYE OF A COD-FISH.

The cornea was removed, and the eye then immersed in dilute chromic acid for three weeks; a section was then made in the axis of the humors. *a*, Sclerotica, within which is a cellular space. *b*, Silvery layer. *c*, Choroid gland. *d*, Pigment and retina. *e*, Space between retina and vitreous body, occasioned by the collapse of the latter. *f*, The vitreous body descending in distinct layers from near the junction of the choroid and iris, and passing to the side and hinder part of the lens. The lens *g*, probably by its weight during the immersion, has pressed out all fluid from the hinder part of the vitreous body, and so, apparently, come into contact with the retina: the hard nucleus of the lens, seen in the centre, is not acted on by the acid; the anterior soft portion has advanced through the pupil.

of the mode of preparation, yet showed the tendency of the structure to split in the direction of the layers. The lamination of the structure was exceedingly evident. Some of the anterior layers, instead of proceeding from the junction of the choroid and iris, which in this eye corresponds with the anterior border of the retina, were derived at successive distances from the suspensory ligament of the lens, which bounds the vitreous in front, extending from the junction of the choroid and the iris to the side of the lens. The explanation of fig. 16, here represented, will further interpret the appearance.

General Conclusions.

The researches now described have not been numerous or varied enough to satisfy me with regard to many points which it is still desirable to clear up; but they will serve, I think, to place in its true light the remarkable phonomenon on which Brücke has founded his view of a very complex and artificial construction of the vitreous body. If I may venture to deduce a conclusion from the experiments I have detailed, I would say that the construction he has described is not in the least supported by the experiments with the salt of lead, which may be made to indicate a lamination in any direction at the pleasure of the anatomist; but, nevertheless, there remains good reason for supposing that there do exist certain layers in the vitreous substance, capable of being rendered visible by art. I think in the sections of the human eye (figs. 1 and 2), the uniformity of the arrangement of the layers disclosed in the neighbourhood of the lens could hardly have been produced, independently of a pre-existing structure, by simple immersion in the chromic acid. The same view is supported to some extent by the appearance of fig. 9, *d*, which could not have been due to a merely physical cause. Then, again, we have the manifest existence of sets of fibres stretching in determinate directions through the vitreous in the eye of the bird, and the still more decisive lamellated arrangement in the fish, which last affords the most striking and conclusive evidence for the artificial conformation of this exquisitely transparent part that we yet possess. The great solidity and weight of the lens of the fish may, perhaps, be the occasion of this.

It is certainly remarkable that in all specimens of the adult human vitreous humor preserved in chromic acid, a central cavity was discovered on making a section of the eye. Now, although this cavity may be regarded as a false appearance, occasioned by the breaking down of the vitreous substance in the central part during the manipulations preceding the immersion in the acid, yet its occurrence in every specimen would seem to indicate that this portion was of a more fragile consistency than the rest, since it is more remote from sources of injury. The cavity could hardly be due to this portion having had time to decompose before being reached by the chromic acid, because the permeation of the whole mass would probably be sufficiently rapid to anticipate such a change.

I may observe, in conclusion, that in a case of phlebitic ophthalmitis, in which the vitreous substance was filled by inflammatory exudation corpuscles, the yellow colour derived from the deposit gave no indication of lamellæ, but made exceedingly evident a flattened cavity in the central part of the vitreous humor, capable of containing a pea. (*See* Case M in the Appendix.)

APPENDIX,

CONTAINING NOTICES OF A FEW MISCELLANEOUS CASES OF OPHTHALMIC DISEASES, CHIEFLY ILLUSTRATIVE OF POINTS REFERRED TO IN THE FOREGOING LECTURES.

Case A.—Small intractable Ulcers of the Sclerotica.

(*Partly from the notes of my friend* Mr. Wyatt.)

July 13th, 1848.—John Kempster, æt. 38, a house-painter, of slender frame, looking sallow and out of health (but never having suffered from colica pictonum), had had slight opacities from his youth, with some dimness of sight in his left eye. Five weeks ago had a lacerated wound of the right brow, and while this was slowly healing, the eye became painful, and discharged much hot watery fluid. He, however, continued his work until last week, when the great pain obliged him to desist.

There is *now* a deep round ulcer, about the size of a mustard seed, all but through the sclerotica, over the ciliary muscle, close to the lower border of the cornea. It looks just as if a small piece had been punched out, the edges abrupt and yellowish, with considerable redness of the surrounding conjunctiva and sclerotica : but no chemosis. The iris and aqueous humor are healthy. On the other eye there is a yellowish deposit in the conjunctiva and sclerotica, in the horizontal axis, close to the cornea, on the outer side, with a little vascularity around. This seems an early stage of what has become an ulcer in the right eye. Tongue clean; bowels confined; appetite very bad; pulse 80, cannot sleep at night. Lunar caustic to the ulcer. Drops of the same (1 gr. to the ounce) every morning.—Pil. Purg. C. gr. v. every night. Quinine gr. j., three times a day.

17th.—The hole now filled to the level with yellow non-vascular lymph. Aching, shooting pain in brow.—Repeat.

20th.—The lymph gone, and the ulcer as on the 13th.

24th.—The ulcer deeper in the centre, where a dark point seems to indicate its complete perforation to the pigment. Aqueous chambers still natural. The surrounding vascularity less, and purplish. The yellow spot in the other eye is more distinct, contains no red vessels, is not raised, but, on the contrary, slightly depressed, as though the conjunctiva were superficially ulcerated over it. Has been living low for three weeks, being out of work, and is besides much depressed in spirits, having six children dependent upon him.—Repeat.

27th.—Has obtained more nourishment. There is some attempt at filling up the gap, which occupies a wider area. The ulcer on the other eye deeper, engaging the sclerotica.

After this he went into King's College Hospital for three weeks, and under a more generous diet and quinine, the ulcers appeared to be rapidly healing. On leaving the hospital, however, he became again reduced to a very poor diet, and six weeks afterwards (October 5th) was as follows:—The right eye without morbid vascularity; the original ulcer about half filled up: its base semi-transparent, unlike the surrounding sclerotica, and with pigment appearing through. The left sclerotica generally pink; the conjunctiva considerably injected. A yellowish non-vascular infiltration into the subconjunctival tissue at the seat of the former ulcer (in the horizontal axis, on the outer side, close to the cornea); and above this at the distance of one-eighth of an inch, also at the confines of the sclerotica and cornea a new ulcer in both textures, circular and deep, like the former ones. Internal parts natural. Aching pain in this eyeball. Tongue clean; appetite good. Battley's Liq. Cinchonæ was freely given, and the Nitrate of Silver drops resumed.

October 12th.—The ulcers remain the same, but there is much more inflammation of the sclerotica and conjunctiva, with pain and mucous discharge.

On the 17th he was taken into St. Thomas's Hospital by my friend Mr. Dixon, and remained there till the 26th December, having been treated during that interval on a strictly tonic plan. Other ulcers had formed, one on the right cornea, but he was altogether in a very much improved state, when he left the hospital at his own desire.

On the 28th December I made the following note:—"There is now a transparent substance filling up the hole in the right sclerotica (the original ulcer), and the other ulcers on the left have healed with little mark. The right iris and lens are in contact with the cornea, and I suppose there must be a fistula corneæ, but I cannot detect its exact situation. This cornea is slightly and irregularly nebulous, and presents some unevenness of surface at the lower and inner part."

A month after, having been again living very poorly, a new ulcer had formed on the right sclerotica, with intolerance of light. The aqueous was regenerated, but the cornea continued a little cloudy. Treatment according to the same principles was repeated.

Cases B.—Sloughing of the Corneæ in the Collapse of Scarlet Fever.

Five boys of one family had scarlet fever during the autumn of last year, when it was so generally fatal. Two lost their sight by sloughing of the corneæ, within a week of their seizure. Of these, one died; the other was brought to me some time afterwards, with the globe sunk, and without the least perception of light. Of the three others, in whom the eyes were not affected, one died, the other two recovered.

There was no previous debility discoverable in these cases to account for this unusual destruction of the corneæ.

Case C.—Central Ulcer of the Corneæ—Healing slowly, without the Development of Vessels.

A boy, æt. 7, of rather feeble health, had slight ophthalmia, with a small speck, for which the ordinary treatment was adopted, but without good result, and after four months, a small central ulcer was found on the cornea, attended with much lacrymation and intolerance of light. It was carefully treated with nitrate of silver, alteratives, sedatives, and tonics, but at the end of a month remained without action, deep, clear, and without vessels. Bark and steel were freely administered and agreed well, and under their use an almost imperceptibly slow improvement took place, until, in about three months, the health was completely restored and the ulcer healed, leaving a dense opacity accurately limited to the affected spot. The healing process had been unaccompanied with the formation of any vessels in the cornea, or even with any nebulosity between the ulcer and the margin. Perhaps this would not have happened if the ulcer had been much nearer to one side than the other, so as to attract the materials of repair from some definite portion of the neighbouring bloodvessels.

Case D.—Sloughing of the whole Cornea, from acute Inflammation—Retention of the Lens by its Suspensory Ligament—Subsequent Progress of the Reparative Action.

October 2nd.—Sarah Stenning, æt. 52, a charwoman, subject to chronic ophthalmia for five years (after erysipelas of the face), eighteen days ago had a "violent cold in the right eye:" the lids were swollen and closed, and she suffered great pain. She was immediately treated by a surgeon, but when she came under my care, five days ago, the cornea was nearly all detached in a sloughing state, and she was very weak and low. I treated her with bark, Dover's powder at night, and soothing applications.

To-day she is in rather better health. The eye presents the following remarkable condition: considerable chemosis, the entire cornea is gone by slough, and the iris and lens are exposed, forming the front of the globe. The iris is covered with a thin film of yellow exudation in the outer two-thirds of its breadth; the inner third, round the pupil, retaining its natural dark brown aspect. The pupil (O) is occupied by the front of the lens, which has *its natural transparency*. The iris is conical, the pupillary border being projected by the lens, which pushes forwards from behind. It is singular that the lens has not escaped. Notwithstanding the transparency of the lens, she has no perception of light with that eye. She has no pain in the ball, only in the brow. Delicate pressure on the globe moves the iris gently on the lens, and shows that the two structures are but loosely adherent, or simply in contact.

She was admitted on the 6th: the lens did not appear to have escaped. The same system was pursued. The iris became gradually covered with a thicker, and at length vascular, layer of soft lymph, obscuring the true texture. At first the pupillary border was simply fringed with yellow lymph; this lymph became red with vessels, and then threw out more on its border, and so on till the pupil (or rather the capsule of the lens behind it) was covered over with organized membrane, only differing from the rest in not having the dark iris behind it. By the 23rd October the whole front of the globe had become flatter, and she suffered hardly any pain.

Nov. 2nd.—The new front to the iris is contracting in circumference. The pupil is marked by a dark spot, into which sinks a small vein, formed from vessels of the new tissue, which are supplied by one of the anterior ciliary arteries. No pain.

9th.—The new covering of the iris is rapidly contracting. The front is flat, and the softened globe is beginning to get squared by the passage of the recti muscles.

Dec. 11th.—The new front is now about half the size of the original cornea, and not further contracting. No pain, and hardly any irritation.

Jan. 25th.—No further change: no irritation. Dismissed.

Case E.—Chronic Ulcer of the Cornea, presenting the appearance of Concentric Rings—Perforation—Escape of the Aqueous Humor—Cure without Adhesion of the Iris.

28th Feb., 1848.—Isabella Ashdown, æt. 5, has a perfectly circular conical ulcer on the right cornea, in which there is an appearance of concentric rings, alternately opaque and transparent. It is a little below and outside the centre of the cornea. The iris acts freely. She was healthy till two months ago, when her father states that she caught cold in her eye. Tongue clean; appetite good; bowels open; pulse weak; no thirst; skin cool. Sod. c. Cinch. gr. v. b. d.; Gutt. Arg. Nitr. b. d.

March 2nd.—The deepest and most central point of the ulcer has given way, and the aqueous has escaped, the iris coming into contact with the cornea and a point near to its pupillary margin falling against the ulcer, without prolapse. General symptoms the same. Very little vascularity around the cornea, none *in* it. On the application of atropine to the conjunctiva, the pupil dilated, and the iris was drawn away from the orifice in the ulcer. Rep. Gutt. o. n.; Extr. Belladon. supercil. o. n.; Sod. et Cinch. gr. viii. b. d.

March 6th.—The aqueous humor restored: pupil dilated. The ulcer healing, opaque, without concentric rings.—Rep.

13th.—Edges of the ulcer smoothed off; surface opaque.

20th.—Ulcer healed, except in the centre: the healed margin and the unhealed centre both opaque.—Rep.

In another fortnight the cicatrization was complete.

CASE F.—INTRACTABLE ULCER OF THE CORNEA, PERFORATING AT ONE POINT, AND AFTERWARDS SLOWLY DESTROYING ITS WHOLE ANTERIOR SURFACE.

GEORGE NOBLE, æt. 52, a married man, of rather sallow complexion, who had rheumatic fever when 13 years old, and has since been subject to rheumatic pains, but otherwise of good constitution, had iritis of the *right* side in 1845, but rapidly got well under cupping, blisters, and mercury. About May, 1847, he had another attack in the *left* eye, from which he recovered by similar treatment, no less promptly, under the care of the same able surgeon, Mr. HOLTHOUSE. In February, 1848, he was again seized with severe inflammation in the same eye (the left), which appears to have involved the iris, but was at the same time attended, either at first or at an early date, with a curved ulcer at the inner margin of the cornea, which at length penetrated to the aqueous humor, and led to prolapse of the iris, and displacement of the pupil inwards. All the remedies which are usual in such a case were judiciously employed, and the perforation closed, but still the ulcer remained, and even enlarged in area, spreading upwards and downwards within the margin of the cornea, till, in May or June, when I first saw the patient with Mr. HOLTHOUSE, it was in shape like a quarter moon, its pointed extremities reaching over beyond the median line, and threatening to encircle the whole cornea. As caustics and astringents had been employed, and bark freely administered, and, as on a careful examination of all his secretions, nothing wrong could be detected, it was hard to discover the reason of so obstinate a form of ulceration, or to devise a rational treatment. There was no syphilitic or other specific taint. As he was suffering much pain, opium was given freely, with sarsaparilla, and the iodide of potass internally, and mild solution of nitrate of silver to the ulcer itself.

No relief being felt from this plan, he came under my care at the Ophthalmic Hospital in July. I then left off all local applications, and gave him Ext. Conii et Pil. Hydr. Chl. C. aa. gr. v. o. n. with a bitter Decoction. At first a favourable change appeared to be taking place; the ulcer had a cleaner surface, and was smaller; the irritation was less; there was still a dull, muddy vascularity of the neighbouring conjunctiva and sclerotica.

Aug. 3rd.—The ulcer is about the same in aspect; the edge, towards the centre of the cornea, very sharply defined; less constant pain,—but a sudden sharp pain now and then seizes him, as if something was in the eye, probably from friction. A new ulceration is appearing on the outer and lower border. The congestion in the vicinity of the old ulcer has a venous character; and one large vein courses over the base of the ulcer. Gums very slightly sore; tongue clean; appetite very good; pulse quiet and regular. He has a worn countenance; has been out of work seven months, and rather badly off for food. —Liq. Cinchon. gtt. xv. t. d.; Ext. Conii, gr. v. o. n.; Gutt. A. N. o. m. Good diet; Beer. The eye to be covered with a light wadding to prevent friction of the lids.

10th.—Decided relief from closure of the lids; but the ulceration is slowly extending. The two ulcers have coalesced, and all but encircle the cornea.—Rep. Liq. Cinch. gtt. xx. ter die.

Sept. 7th.—More irritation. The ulcer encroaches slowly on the central part of the cornea, but is not so deep; and at the inner border is healing up to the level, and contains large veins.—Castor Oil to be dropped in frequently to diminish friction. An issue in the temple. Continue the Bark and Hemlock.

14th.—The eye has been "very easy." The ulceration is not deep, and vessels shoot into it. The central portion of the cornea, which has been hazy, is clearer.—Rep.

21st.—Steady improvement. The ulceration does not spread, but is filled up nearly to the level of the central part, which is clear. The ulcerated part is defined by an abrupt line from the healthy cornea, and is opalescent. On the inner side, in the seat of the original ulcer, it admits of our seeing the iris through it.

28th.—More irritability of the eye, and pain in the cheek. The ulcerated parts, though not so deep, are more extended, and occupy all but a central portion of a quarter of an inch wide.—Rep. Pulv. Ipecac. C. gr. viii. o. n.

Oct. 23rd.—Little alteration. The eye has been, on the whole, quieter; but every now and then becomes more irritable for a few days. Still has the issue.—Rep.

30th.—More aching pain in the globe. The ulceration is nowhere deep, only slightly below the level of the remaining cornea, and looks like a very old vascular leucoma, having vessels of considerable size running into it from the conjunctiva and sclerotica. The remaining non-ulcerated portion is more opaque. There is nothing new in his general state, and no new injection of the eye.

Nov. 8th.—The remaining portion diminishes by encroachment of the ulcer, which still exhibits no tendency to advance into the deepest layers. A vessel from the outside shoots into the central part, which is quite dull.

27th.—He suffers much less irritation; has had no sharp or severe pain for some time; sleeps very well; feels very well; no bulge of that portion over which the ulceration has extended; the ulceration still slowly spreads.

Jan. 25th, 1849.—There is now but a small point of the cornea of its original level; very little irritation.

Feb. 1st.—The whole original front of the cornea now gone. The new surface is opaque, smooth, on a level with the conjunctiva scleroticæ, and traversed with a few large purple veins. An ulcer occupies the spot where the last remnant of the original surface was situated, and threatens to perforate.

March 1st.—This ulcer continued stationary for a few weeks, but is now nearly healed. The cornea has its natural curvature, though formed only by the posterior layers, fortified by leucomatous deposit and vessels. Though it is very opaque, he can distinguish large objects. The eye gives him no distress. The irritation appears to be permanently subsiding.

CASE G.—CHRONIC VESICATION OF THE CORNEA, IN AN EYE THE SEAT OF SLOW DISORGANIZING ACTION.

(*Under the care of* MR. DIXON.)

Feb. 7th, 1848.—LUCY DUDGEON, æt. 48, a phlegmatic, pale-looking, nervous woman, older in look than in years, has had glaucoma, with cataract and staphyloma scleroticæ of the *left* eye, for three years. The *right* eye has for a year been gradually becoming impaired. The deep-seated vessels are large, and easily fill on irritation; the pupil is large—irregular; sight very dim; has had scintillations, &c.

The cornea is perfectly clear; but the epithelium over one-fourth of the area, near the centre, is loosened from the cornea, with a very little fluid beneath it, as in a vesicle. When the lower lid is pushed upwards, against and over the cornea, the loose epithelium is wrinkled, and bulges with the fluid behind it. When the front of the cornea is untouched, the epithelium lies smooth, so small is the quantity of the enclosed fluid. This affection seems a consequence of general impairment of nutrition in the organ, and not of any inflammation in the cornea, which is quite transparent. I have seen the same state in several other instances.

CASE H.—ACUTE GLAUCOMA; SUBSEQUENT SLOW DISORGANIZATION OF THE CORNEÆ; AND (IN ONE EYE) ESCAPE OF THE HUMORS AND RETINA. EXAMINATION OF THESE STRUCTURES.

June 26, 1848.—MARY KILBY, æt. 54, was led to the Ophthalmic Hospital, having been totally blind for nine months. She had suffered from bad health for some time, with occasional slight dimness of sight, when she was taken ill in the street, with some head affection, of which she does not give any distinct account, but it was unattended with paralysis or loss of consciousness. Being taken home, she found herself totally without sight next morning, and she has not had the least glimmer since. The attack was attended with great pain in the temples, which has been, and still is, her principal grievance. She kept her bed for seven months.

Present State of the Eyes.—The cornea dewy, as though breathed upon; scleroticæ contain large congested vessels; irides brown and slate-coloured; pupils dilated, irregularly oval, and fixed; lenses greenish and semi-opaque. She has constant pain in the brows, or, if not there, in the occiput, aggravated at intervals.

Appetite very good; bowels regular; tongue clean; usually sleeps well. Tartar emetic ointment to the temples; Haust. Pot. Iodid. bis die.

Oct. 2.—Less pain in the brows; irritation of the right globe from vesication of the conjunctival epithelium of the cornea, a portion of which is detached. The rest is dim.—Guttæ Zinci Sulph. o. m.

30th.—The right cornea opaque: its surface dim, especially near the centre, with more inflammation.

Dec. 2nd.—The right cornea thickly nebulous in the inner half, with imperfect *pannus.* The left cornea is in process of slow disorganization; the anterior layers are loose and flaccid, as though in a state of slough, and yet they do not separate. On the outer side there is a semi-circle of opaque yellow deposit in the lamellæ, a little way from the margin; there is also much chronic vascularity of conjunctiva, and tendency to chemosis. Much pain in the left eye, and some in the right. That in the left eye and brow is sudden and darting, night and day, and often so severe as to cause her almost to start from her chair; yet her appetite is good, and she says she is "pretty well in health."—Emp. Lyttæ pone aur. sinist.; Ung. Hyd. c. Opio supercilio.

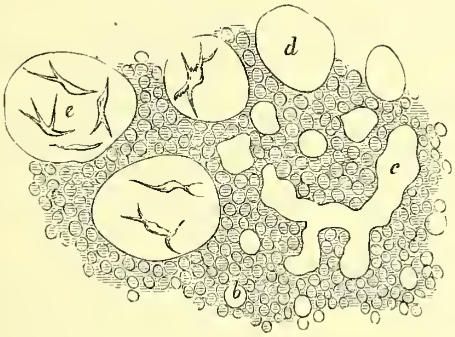
11th.—She reports that on the 9th, as she sneezed, the left eye burst and bled, with severe pain. I find the cornea has given way at the point previously sloughing. The whole cornea, except a narrow rim, has separated, leaving the iris exposed, with the lens pressing forward, but not apparently inclined to escape. In this state of things, as she was suffering very much, I thought it might relieve her much to remove the lens, which I accordingly did, leaving the capsule *in situ.* The capsule was of quite horny consistence, and when incised the soft substance of the lens escaped, looking nearly of its proper transparency. The nucleus, I think, remained in the eye, for as a little vitreous humor was beginning to escape, I desisted from any further attempt to extract it.

14th.—The eye has been much easier since the operation. It continues to discharge, but no blood. Still much headache. She was now received into King's College Hospital.

During her stay here she was still a great sufferer from aching and throbbing pain in the brows, chiefly the right; and in the course of about a fortnight (Dec. 29th), the right cornea gave way as the left had done, but in this instance the separation of the slough was attended with forcible protrusion of the lens, the whole vitreous humor, and the retina. Considerable hæmorrhage attended this grave accident, but it was readily arrested by slight compression of the lids. By the prompt zeal of Mr. S. J. A. Salter, the house surgeon, who was at once called up by the nurse, and found the protruded parts on the patient's cheek, I was enabled to examine them when perfectly fresh, and as such opportunities are very rare, I shall relate the exact condition in which we found them.

The *lens* could not be found. The *vitreous humor* was perfectly pellucid—neither yellow nor green—and of its natural consistence. The *hyaloid membrane* was also natural in appearance. In the substance of the vitreous near the hyaloid were seen a few irregular granules.

The *retina* had to the naked eye very much its ordinary appearance. Under a high magnifying power, its outer surface presented in some places the usual series of the rods (*a*), and bulbs (*b*), of Jacob's membrane in their natural arrangement and proportions, but in others, certain departures from the healthy condition were noticed, which are imperfectly represented in the woodcut, fig. 33.



a, Ends of the rods. *b*, Bulb of Jacob's membrane. *c*, Light space apparently formed by the coalescence of several bulbs. *d*, Large circular light space. *e*, Another with included caudate bodies.

FIG. 33.—EXTERNAL VIEW OF A PORTION OF THE RETINA (CASE OF GLAUCOMA). MAGNIFIED 350 DIAMETERS.

There were numerous transparent spaces among the rods, some seeming to be formed by the running together of adjacent bulbs (*c*), others by the great enlargement of the bulbs, or of the beds in which these had rested (*d*). These latter large transparent spaces seemed to occupy nearly the whole thickness of the retina, where they were close together: the retina looked cribriform. They were occupied by transparent fluid, in which lay a few small and very delicate caudate bodies, like small caudate nerve-vesicles, but without nuclei (*e*).

In the middle of January she left the hospital, still suffering a good deal of pain in the region of the brow.

CASE I.—SYMMETRICAL OPACITY OF BOTH CORNEÆ, EXTENDING HORIZONTALLY OVER THE CENTRAL REGION, AND OBSTRUCTING VISION; CONSISTING OF AN EARTHY DEPOSIT LIMITED TO THE ANTERIOR ELASTIC LAMINA, AND SUCCESSFULLY REMOVED BY OPERATION.

James Kemp, æt. 55, for forty years a house-painter, a man of healthy constitution, but of late reduced by deficiency of food, arising from want of power to follow his occupation, came under my care in January, 1849. On each cornea was a horizontal band, of brownish opacity, extending from side to side, and so much broader opposite the pupil as completely to hide it from view, unless the pupil was dilated, or was examined either from above or below, through the still transparent cornea. Both the iris and the pupil could then be seen to be perfectly natural and active. When the pupils were considerably dilated, he obtained some useful vision, especially with the left eye, where the opacity was not quite so extensive as on the right. The opaque part was very finely mottled with dark dots, some of which were only to be seen with a lens : its margins were shaded off rather abruptly, and the cornea beyond them was perfectly clear. The opacity had the appearance of occupying a superficial position, and of being very slightly raised, but the surface reflected the light as brilliantly as other parts. The shape of the opaque tract was peculiar in being slightly inclined downwards from the inner side, so that its lower edge in each eye corresponded exactly with the margin of the lower lid, when the eyes were directed to a near object. The inner end of the opacity in the left eye was traversed by a narrow line in which the cornea was as transparent as ever.

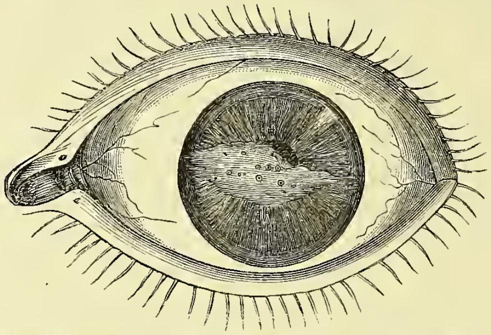


FIG. 34.—LEFT EYE OF KEMP, SHOWING THE APPEARANCE OF THE OPACITY, WHEN THE PUPIL WAS RATHER MORE THAN USUALLY DILATED. MAGNIFIED TWO DIAMETERS.
He could then see his way about, the light entering above the opacity. Drawn by Dr. WESTMACOTT.

The singularity of these opacities led me to inquire particularly into the man's history. He had had an ophthalmia ten years before, lasting only a fortnight, and leaving no blemish. After a period of about three years, his wife noticed that he had a speck on each eye, but as his sight was perfect, he doubted it. After two or three years more the specks were more evident to others, and he began to find that in a strong light his sight was clouded, so that he applied for relief at the Ophthalmic Hospital, and remained a patient there for about two years, during which he was treated with drops and lotions, but rather got worse than better : in fact, the opacity seemed confirmed and incurable, and was steadily encroaching over the front of the pupil. Within the last year he has been quite thrown out of work, able to see only in an obscure light, and then only objects on one side.

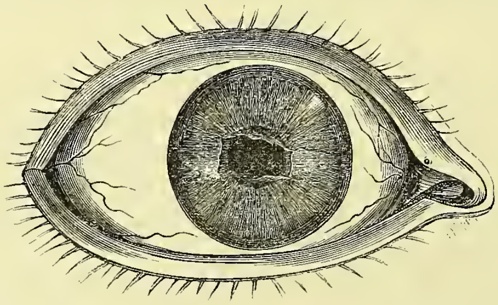
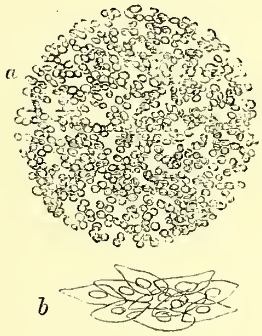


FIG. 35.—RIGHT EYE OF KEMP, AFTER THE REMOVAL OF THE OPACITY FROM OVER THE PUPIL, WHICH IS HERE SHOWN DILATED MORE THAN ORDINARILY. MAGNIFIED TWO DIAMETERS.
From a drawing by Dr. WESTMACOTT.

Like those who had previously seen him, I regarded these opacities as indelible, but as he came from time to time, it occurred to me to make an attempt to shave off a portion of one of them, in order to examine its nature more completely. I accordingly made the patient come from the hospital to my house, where I could at once place any particle I might be able to detach under the microscope. The first scratch with the point of the lancet on the right eye (January 20th) detached the epithelium, which seemed healthy, and brought me down upon the opacity, which felt hard to the instrument, and had a smooth surface. In scraping and trying to slice off a thin film of it, a thin flake cracked off and separated, leaving what seemed a hole through the cornea; but the aqueous did not escape, and I then saw that the pupil was visible through the perfectly transparent lamellated texture, behind the opacity. It was now easy to chip off the opaque film over a space corresponding to the pupil, and when this was done he could see large letters plainly, for the exposed surface was nearly smooth.

The pain attending this little operation was great, and the poor fellow fainted; but the subsequent inflammation was slight, and in a few days the epithelium was restored, without any return of opacity, and he could see very much better.

The fragments which had been removed became of an opaque white when dry, and when examined under a sufficient magnifying power presented the appearance of an aggregation of rounded, highly refracting grains, disposed in a sort of network. They all lay nearly in one plane, and the epithelium which had covered them was perfectly healthy.



a, Earthy deposit on the front of the cornea. Magnified about 150 diameters. *b*, Epithelium covering it in a healthy state.

FIG. 36.—CASE OF KEMP.

Having a vague notion, derived from the shape of the opacities, that the deposit might possibly consist of some material exhaled from the paint he had so long used, I requested my friend, Professor Miller, to examine it with chemical tests under the microscope; and, though the result did not bear out my conjecture, I shall give it in Dr. Miller's own words.

"*Chemical Examination of a Superficial Deposit upon the Cornea.*

"Jan. 22, 1849.—Placed in *acetic acid*, the granular matter very slowly dissolved out of the tissue containing it.

"*Hydrochloric acid* attacked it briskly, attended with effervescence, and completely dissolved it.

"*Ammonia*, added to the hydrochloric solution, caused an amorphous coherent precipitate, mixed with a few of the well-known serrated stellate crystals of phosphate of magnesia and ammonia.

"*Oxalate of ammonia*, added to the preceding, produced a uniformly diffused, coarsely granular precipitate of oxalate of lime.

"*Hydrosulphate of ammonia* produced no blackening, showing the absence of lead.

"The deposit, therefore, appears to consist of the same ingredients as ordinary bone—viz., phosphates of lime and magnesia, with a considerable proportion of carbonate of lime."

On the 22nd February, the area exposed by the operation on the right eye remaining clear, I performed the same operation on the left, and with precisely corresponding results, so that in a few days afterwards he could see almost as well as eight years before. With this eye he could, in fact, with some care read the type called "Pearl type"—viz. (London.)

The above case is one of those referred to in the Lecture (p. 133), as of a brown tint, chronic course, non-inflammatory origin, and liable to affect both corneæ at the same time; and I think it is evidently seated in the anterior elastic lamina, as there surmised. I had seen four or five examples of it, but had till now deemed it irremediable. The issue of KEMP'S case I am anxious should be known, because there are probably many similar ones scattered over the country given up as incurable, and yet within reach of this method of relief.

CASE J.—SYMMETRICAL OPACITIES, VERY SIMILAR TO THE LAST: REMOVED BY OPERATION.

(*This case was treated by* Mr. DIXON, *to whom I am indebted for the following notes.*)

J. T., a cabinet-maker, æt. 58, applied at the London Ophthalmic Hospital, October 16, 1848, complaining of dimness of sight, which had been gradually getting worse for the last six months, until it had entirely prevented him from following his trade. His eyes, when cursorily viewed by a person placed directly in front of him, seemed to have no pupillary apertures; but on closer inspection it was found that this appearance was produced by a transverse, opaque band, passing along the equator of each cornea, so as entirely to hide the corresponding portion of the iris. These bands were of a brownish tint, closely resembling that of the irides, about a line and a half in breadth, and gradually shaded off at their edges, leaving the upper and lower portions of the corneæ perfectly transparent, through which an oblique view of the pupils could be obtained. These were rather small, but perfectly normal, and the patient could readily distinguish an object placed above or below the level of the eye. Except the opacities of the corneæ, no morbid appearance could be detected in either eye; and the patient stated that there had been no inflammatory symptoms during the time the dimness had been coming on.

Counter-irritation, by means of issues in the temples, stimulant applications, and mercurial frictions around the orbits, having been employed in succession without any result, I tried to remove the opacities by operation. On February 19th I carefully scraped off the epithelium from the centre of the right cornea, and found a very thin layer of hard matter beneath it. This was closely united to the proper substance of the cornea, and could be raised from it only in small flakes, and with considerable difficulty. When this opaque deposit had been entirely scraped off, the cornea beneath it was found to be perfectly transparent. The patient complained of extreme pain both during and after the operation, and I applied to the denuded surface a drop of castor oil, which I have always found to be the most soothing application in those very painful cases in which the epithelium has been scratched or roughly stripped off from the surface of the cornea.

By the 1st of March the irritability of the eye had subsided, and the spot where the opacity had been removed was covered with new and perfectly transparent epithelium.

[In the following week Mr. DIXON repeated the same procedure on the left eye, the result of which was a very great improvement of vision, and a restoration of the cornea in front of the pupil to its almost perfect transparency. The fragments removed became opaque when dry, like those in KEMP'S case, and on being chemically tested by Professor TAYLOR, were found to consist principally of lime, either in the state of phosphate or sulphate.]

Case K.—Penetrating Wound of Globe, followed by destructive Inflammation in that Eye, and considerable damage to the other: illustrating one variety of Corneal Opacity.

(*From the notes of my friend* Dr. Grieve.)

Aug. 3rd, 1846.—F. G., æt. 42, a poor woman, reduced in health and spirits by repeated ill-usage on the part of her husband, received a blow on the *left* eye from a teacup, which he threw at her in a state of drunkenness. The wound bled profusely, and was very painful. No treatment was pursued for ten days, when she applied at the London Ophthalmic Hospital. There was a penetrating wound, half an inch long, through the sclerotica and choroid on the outer side, and a clot of blood behind the lens, which remained transparent. The iris was adherent to the lens on the side of the wound, and she was totally without sight in that eye.—Active treatment being out of the question, Mr. Bowman applied a blister and fomentations.

13th.—The wound is healed, with only a slight collapse of the globe. The lens is transparent, and there is a slight glimmer of light. She is suffering from poor diet, and anxiety about her children.—She now took quinine and better fare, and improved considerably in health, but the eye got no better.

Sept. 24th.—Lens opaque towards the outer side, where the iris adheres; iris turbid; vision almost entirely gone: she can just distinguish where the window is, and a hand passing across. Much pain in the eye.—Hirud.; Mist. Ferri C. ℥j. bis die.

Oct. 8th.—The lens now opaque.

15th.—The anterior chamber appears to be encroached upon by the iris, which is pushed forwards, probably by the deposit of lymph on the ciliary processes. The *right* eye has been getting dim for a fortnight. Its cornea is now covered in the central region with minute circular specks. The pupil is bordered with a black rim of *uvea*, and the contiguous part of the capsule seems muddy. Under the influence of atropine the pupil dilates, leaving, however, on the front of the lens a circular line of dirty-looking lymph, corresponding to its former position. Vision is improved by the atropine, as the cornea is clear except in the centre. She is very feeble and depressed.—Rep. Mist. Ferri C.; Ext. Belladonnæ supercilio dextro.

22nd.—Right lens now perfectly clear; specks on the right cornea as before. The left cornea presents large spots of opacity, like mould-spots.—Lot. Aceti.

Nov. 12th.—The left cornea is now almost completely obscured by opaque deposit of the same kind as before, but in larger flakes. The sight of the right eye is much impaired: though this lens is clear, the cornea is still studded with a dense cluster of very minute but distinct round spots as before.—Rep. Capt. Ammon. Carb. gr. v. bis die ex Infus. Gent. C.

Dec. 3rd.—The opaque deposit has disappeared from the left cornea. The pupil is full of lymph, and the lens bulges forwards, with great pain.—S. Quin. Disulph. gr. ij. bis die. Hyd. c. Cret. gr. ij.; Pulv. Doveri, ℈ss. o. n.

Jan. 21st.—There is less pain, but she still suffers much in the night.—℞ Potass. Iodid. gr. iij.; Decoct. Sarzæ, ℥ij. bis die.

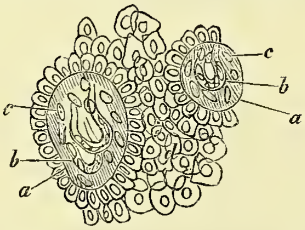
Feb. 18th.—The *left* eye is now in a quiet state, and without pain. The overcharged vessels are all diminished in size. The pupil is still occupied by a *yellow* mass, which seems to be the lens covered with a layer of lymph, which is indisposed either to be absorbed or to become vascular. The margin of the pupil, however, adheres to it, and seems to send a few minute vessels a very little way into it. Vision, of course, entirely lost in this eye.

The morbid changes in the *right* eye seem to be at an end. The cornea is still dotted with dark brown and very small circular specks, not very obvious without a glass, and the deeper textures are probably impaired, for she cannot see small type, or to thread a needle. General health much improved.

She continued in attendance for several months after this, but no further change occurred in either eye. It was impossible to ascertain with certainty in what part of the corneal textures the minute specks above described were situated.

Case L.—Warty Opacity of the Cornea, relieved by operation.

July 13th, 1848.—Mrs. Goldsmith, æt. 38: has an old-standing prominent opacity of the right cornea, lying in a transverse position just below the centre, and extending completely across, corresponding to the interval between the lids. The iris is adherent to it. It followed a severe ophthalmia four years ago. The lids seem to have moulded the opacity, for it ceases abruptly above, at the line which the margin of the upper lid forms when partially closed, and this lid in passing down over the cornea seems to be stopped by coming against the prominent edge of the opacity. Its surface is rough, like that of a soft corn. Its prominence seems to fret the lids, and keep up chronic inflammation. She has been in attendance for a year or more, and finding no benefit from various astringent applications, I about six months ago shaved off a very thin layer from the surface, expecting to find papillæ developed, as in the case of a similar looking opacity in the eye of an animal which I had examined, but I could see nothing but thickened epithelium.



a a, Basement membrane. *b b*, Capillary loop. *c c*, Nuclei within papillæ. *d*, Conjunctival epithelium.

FIG. 37.—HORIZONTAL SECTION OF A WARTY OPACITY OF THE CORNEA. MAGNIFIED 150 DIAMETERS.

To-day she presents herself with the opacity as above described. She thinks the removal of the former portion has diminished the prominence, and I think so too. I have therefore now sliced off the opacity down to the level of the healthy cornea. The cut surface bled at numerous points (blood oozed from the whole cut surface); and when I examined the slices under the microscope, I found them to contain a great abundance of papillæ, which had, of course, been cut across: many of these had still blood in their vessels. The epithelium was very thick about them and over them, and they had not been reached in the previous operation. The interior of the papillæ consisted of bloodvessels and an obscure tissue, with many nuclei. (*See* fig. 37.) The operation gave her very little pain. No nerves were seen by the microscope.

Oct. 5th.—The part is much flatter, and her sight is improved.

Case M.—Phlebitic Ophthalmitis after amputation: with an account of the post-mortem examination of the Textures of the Eye; and remarks.

(*This case appeared in the 'London Medical Gazette' of October* 30*th*, 1846.)

Early in August, 1846, in consequence of Mr. Simon's absence from town, I assumed the care of a young man, whose leg he had amputated about ten days previously, on account of disease of the ankle and tarsus.

The case was going on unfavourably: there had been a shivering fit on the fifth day from the amputation, followed by decisive symptoms of inflammation of the veins of the stump, advancing even above the groin. He was already in a state of high irritative fever, with a sallow and exhausted countenance; and on the 5th he was attacked with diarrhœa, which required starch and opiate enemata, with small doses of gray powder and Dover's powder. This symptom soon ceased, but bed-sores were appearing, and he had repeated rigors, with parched tongue, very rapid pulse, a hot skin, and an anxious and sunken look, which indicated serious internal disease. The stump itself was meanwhile assuming a more healthy action, and the ligatures had separated; yet there was some projection of the bone, in spite of our efforts to prevent it.

On the morning of the 6th he complained of his left eye smarting and aching, and it appeared to be affected with slight catarrhal ophthalmia. There was superficial redness, with mucous discharge. Alum lotion was applied.

On the following day the inflammation had increased with frightful rapidity: there was excessive florid chemosis, partly concealing the cornea; the lids were turgid, and the eye wanted none of the characters of a severe attack of purulent ophthalmia, except the purulent discharge. The pain in the globe was of an aching darting kind. The cornea remained clear, but the aqueous humor and iris were muddy, and sight was totally lost. The chemosed membrane was scarified, and four leeches were applied, which had the effect of speedily reducing the scarlet colour of the conjunctiva to a pale yellowish-pink tint, and the chemosis became of that sort which is known as "serous." This speedy change was accelerated by his weakened state, and showed that active depletion was inadmissible. Fomentations were then applied. The general treatment was continued, with an opiate at bed-time.

On the 8th, dull pain in the eye continued, and the chemosis had increased and projected between the lids, but was pale and serous. The cornea had become cloudy, the chambers were yellowish, the iris obscured by lymph, the pupil occupied by a yellow mass of lymph, which looked like an opaque lens. The lids had become less œdematous, so that the condition of the interior of the organ could be more exactly noted. Meanwhile the local symptoms of phlebitis in the stump were on the decline, and the stump assumed a more healthy aspect, the bone still protruding slightly. But the rigors now recurred daily, with considerable regularity, attended with much exhaustion; and about the 15th he was seized with pleurisy of the right side, for which he was blistered, and took a grain of calomel with opium every four hours for two days. At the end of this period the pain in the side had nearly subsided, and (what is interesting) the lymph was absorbed from the iris and the pupil, which resumed very nearly their natural appearance, the latter only remaining rather turbid. He had lost almost all pain in the organ, and the morbid action within it seemed entirely checked. Some pale chemosis remained, but the cornea was clear, and the globe wore no appearance of internal suppuration. All pain in the organ had likewise ceased.

On the 20th he died, after an aggravation of the symptoms betokening internal phlebitic abscesses.

I examined the eye before twenty-four hours had elapsed, and had appointed an hour for the inspection of the rest of the body; but this was unfortunately prevented by the interference of the friends.

The following is the result of a careful and deliberate examination of the eye itself:—

The *iris*, seen through the transparent cornea, was clear green, without lymph on its surface, but firmly adherent by its entire posterior surface to the capsule of the lens, which presented only a partial opacity near its centre. This posterior synechia and opacity of the capsule appeared of old standing (and the patient had stated that this eye had been a poor one, and vision imperfect with it for many years).

The *lens* itself was *perfectly transparent*.

Under one of the recti, immediately behind its insertion, the sclerotic (and also the choroid) was much bulged, and so distended as to be almost giving way, evidently by pressure from within. It formed what would have been termed, from its shape and circumscribed figure, a staphyloma scleroticæ. In order to ascertain its nature, I carefully cut all round it through the sclerotica only, and in detaching this coat I found that it was extremely thin, and its fibres as it were unravelled at the apex, where also the choroid was adherent to it by a film of recent lymph, and, like the sclerotica, distended from within. The outer surface of the choroid was perfectly natural, except at the apex of the swelling. On now cutting through the choroid, a whey-like fluid, with particles of lymph floating in it, escaped in abundance; and I found that this effused fluid was filled with nucleated and other irregular granules, hanging together in little masses, and resembling lymph rather than pus. In this turbid fluid there lay loosely a great number of smooth, round, or oval beads of soft yellow lymph, of every size up to that of a rape-seed, and these consisted of an agglomeration of nucleated lymph-particles, with many shapeless granules in the connecting material. Scarcely any fibres could be discovered. I emptied the cavity between the choroid and retina, in which this effusion had collected, by syringing it under water, and the inner surface of the choroid then exhibited a coating of yellow lymph, which appeared to be deposited not merely on the surface, but also in the interstices of the capillary network which lies under the epithelium forming that surface; almost all trace of this epithelium (the "membrane of the black pigment" of Mr. Wharton Jones) being lost. The vitreous humor, in its enveloping hyaloid membrane, together with the broken remains of the retina, had been thrown by the effusion to the central part of the globe, where they occupied only about half their natural space. The retina was not at all coated with lymph, and its capillary network was perfect, but the nervous substance was in a great measure destroyed, as though macerated; yet what remained exhibited the characteristic elements of the nervous substance of that part. In particular, I discovered several well-marked examples of the *caudate nerve-vesicles*, which I had never before unequivocally seen in that membrane, although strongly suspecting their existence. Jacob's membrane was nowhere visible.

The hyaloid capsule (that homogeneous glassy membrane which forms the outer covering of the vitreous humor, and in the adult eye shuts it off, as the capsule does the lens, from the capillary bloodvessels of surrounding parts, and constitutes it a non-vascular texture)—the hyaloid texture, was everywhere entire, but thrown into innumerable minute folds, in consequence of its collapsed form. A good many lymph-globules were accumulated on its exterior in certain parts, and the nuclei naturally present on its inner surface were very distinctly visible. But what I wish specially to notice was the state of the vitreous humor itself. This highly delicate structure, from its transparency and exquisite texture, displayed with remarkable clearness the morbid changes that had been taking place within it. In a state of health the vitreous body presents no corpuscles, but here every part of it was turbid and cloudy, from a finely granular and amorphous deposit in its substance. This deposit might be supposed to be a simple coagulation of albuminous matter; no trace of organization could be detected in it. But, in addition to this, there were disseminated through the vitreous humor innumerable nucleated cells, like those of the lymph already described. These nucleated particles were much more numerous immediately within the hyaloid capsule, in the superficial portions of the vitreous humor, than towards its centre, where they very gradually ceased. They were all distinct from one another, placed apart in the vitreous tissue, and had everywhere the same appearance and size. Mingled with them, however, were several smaller, more granular, and irregular particles, which might be in process of development. I could perceive no appearance indicating a multiplication of the particles by splitting or division. In the central part of the vitreous humor there were none of the nucleated particles, but in the neighbourhood of the optic foramen and yellow spot, and particularly near the ciliary processes at the border of the lens, and near its posterior surface, they were so abundant as to render the vitreous humor perfectly opaque and yellow; yet even here they only differed in number from those found elsewhere.

Remarks.—In this case the death was consequent on phlebitis and secondary inflammation, and probably suppuration of the viscera. The course of the symptoms, and especially the attack on the eye, render this as certain as can be, in the absence of an examination of the internal organs. By a reference to the recorded cases of destructive inflammation of the eye in such circumstances, their course will be found very variable, both in duration and severity. In some the eye has gone rapidly into general suppuration and discharge of the contents of the globe; in others, the organ has retained its figure, and the inflammation has been checked, after it has destroyed the integrity of the most important tissues.

The place at which the globe gives way under a distending force from within is well illustrated here. By exact examination it will be found that the sclerotica is thinner immediately behind and under cover of the insertion of the tendons of the recti than at any other points, these tendons grooving the fibrous coat slightly before their actual insertion into it. The bulge of this tunic was precisely at one of these weak points in the present case; and I believe it will be generally found that suppuration of the globe (not a consequence of conjunctival or corneal inflammation) will discharge itself in a similar situation. I have heard of the sclerotica being opened at this point by incautious use of the scissors in the operation for strabismus.

The principal seat of the effusion of lymph in this case is very interesting to notice, if we bear in mind that the choroid membrane, from which it seems to have proceeded, has its capillaries on its inner surface; its arteries, and especially its ample veins, on its outer surface. The effusion was on the inner surface, and clearly from the capillaries: the arteries and veins forming the outer surface were quite healthy; there was not a particle of lymph about them, except where the tunics were giving way.

The deposit was of lymph—of lymph consisting of little else than nucleated cells which formed masses of rounded shape, floating in a turbid serum. It may be supposed that those which had been effused from the surface of the iris under the mercurial action were of a similar kind.

The capillaries of the retina, and the nervous tissue of the retina, though to some extent macerated and disorganized by the contact and pressure of the effusion within the choroid, yet did not appear to have any lymph adhering to them, or to have themselves exuded any.

The presence of the nucleated lymph-particles in the tissue of the vitreous humor within the homogeneous hyaloid membrane which separates the vitreous humor from the contiguous capillaries, seems to me a fact of great importance to the question of the source and mode of formation of such effusions. The opinion that pus is absorbed from suppurating surfaces and carried by the bloodvessels to distant organs, and there deposited anew, is one which, however it may seem, at a cursory glance, to explain the phenomena of "secondary depositions," yet will hardly bear a rigorous scrutiny. How can pus or lymph-globules be absorbed by vessels which certainly have no open mouths? And how, admitting such globules to be in circulation in these cases, could they get out of the capillaries, and find their road, as here, through a homogeneous membrane such as the hyaloid, into the interior of the vitreous humor? The anatomical conditions here present seem demonstrative that these nucleated cells, lymph-corpuscles, or exudation particles, were formed at the spots at which they were found, from effusion, strictly fluid, through the capillary wall, the hyaloid membrane, and the vitreous tissue. It is interesting to observe that their relative numbers were far greater in those parts of the vitreous humor where it may be presumed that the ordinary processes of nutrition are carried on the most actively, and especially between the ciliary processes and the lens.

We see, in this instance of the morbid products of inflammation occurring in a non-vascular part, decisive proof of the possibility of real imflammation arising in that class of structures without their having vessels, and without their becoming vascular; and we find proof, also, of the subordinate or ministerial part which the bloodvessels play in inflammation—of their being, in reality, the channels only of the supply of that fluid, a certain change in the constitution of which forms the essential condition of the process. But of course where large masses of vascular tissues are inflamed, the bloodvessels must share largely in the production of the resultant phenomena.

CASE N.*—OPHTHALMITIS, SIMILAR TO THAT OF THE LAST CASE, BUT NOT SO CLEARLY OF PHLEBITIC ORIGIN, ACCOMPANYING EXTENSIVE INFLAMMATION OF THE HEART AND BRAIN.

A. B., a medical student, who had been the subject of severe rheumatic fever when a boy, and continued to have a diastolic bellows-sound over the cardiac region subsequently, though otherwise in apparently good health, began to feel indisposed in the commencement of August, 1847. There was nothing, however, to alarm him, or to induce him to abandon his ordinary pursuits, and he even undertook to dress some patients for a friend on the 26th of the month, when he was seized on the 27th with sickness and diarrhœa, with much depression. The diarrhœa continued for four days, and then ceased. It was attended with great exhaustion, and a dry, furred tongue, and it was feared he might be suffering from the typhoid fever then prevalent. Saline medicines, opiate enemata, fomentations, and, on the 30th, ammonia, were employed.

On the 28th he discovered that the sight of the left eye was impaired, and on the following day he could not distinguish light from darkness. All this was without any scintillations, or other symptoms of retinitis, as ordinarily described. He had, however, some dull, deep-seated pain in the globe, but not extending to the brow or head.

On the 29th twelve leeches were applied round the eye. They relieved the pain for a short time but the blindness was complete; and on the 30th a blister was applied to the temple.

On the 31st I was requested to see him, in consultation with Dr. TODD and Mr. BLOXHAM, with regard to the state of the eye. I found him totally amaurotic in this eye, in which he still complained of a dull, deep-seated, beating pain. The pupil was half dilated, almost immoveable. The humors quite clear. No morbid appearance in the tissue of the iris, which was of a dark brown. Slight conjunctival and sclerotic injection. The pulse was above 100, and had rallied under the ammonia. Tongue dry and brown. Some tenderness of abdomen over the region of the colon. A *bruit de soufflet* was heard over the heart, probably such as was known to have previously existed. Considering his prostration, which was such that he was unable to walk, and also the state of the bowels, it was a question whether to give mercury, though the state of the eye seemed so imperatively to demand it. It was agreed to rub in mercury, and to apply four leeches to the eye, with fomentations, and to continue the ammonia, with beef-tea, &c.

Sept. 1st.—The pain continues in the eye, though mitigated: more injection of the conjunctiva, and disposition to chemosis. The margin of the pupil slightly irregular, otherwise the eye appears the same; the general symptoms are the same.—Ext. Bellad. ad frontem. Rep.

2nd.—A more sunken countenance; the eyelids somewhat swollen; decided serous chemosis, overlapping the cornea a little. Humors clear. Iris apparently natural, except that the pupil is puckered. The pain in the eye as before, deep-seated and aching, not acute or intolerable, or preventing sleep. He complains of soreness and pain in the right shoulder, and on examining this and other joints, we found effusion in the left knee (query, rheumatism, or purulent infection ?). It was deemed well to continue the inunction, as no mercurial action had yet manifested itself. Two glasses of sherry, beef-tea, arrowroot, a blister to the knee, and behind the ear.

3rd.—To-day more prostration. Tongue coated, moist; pulse 120; weaker. Has wandered, and slept little. More serous chemosis, projecting a little between the lids, which are swollen, but allow us just to see the cornea. This is clear, and so is the aqueous humor. The lens has a pale, milky tinge, especially at the border of the pupil, which is irregular. Front of the iris natural. Pain in the eye not severe. Total blindness continues in this eye. The mercury has produced very slight soreness of the gums. He complains of some pain about the base of the chest, and catches at the breath. A friction sound over the heart. The lungs everywhere pervious. The effusion in the knee has disappeared. Is so low that he must omit the mercury.—Capt. Quin. gr. ii. 4tis horis, c. Tr. Opii, ♏ v.; Morph. Acet. gr. ⅓, horâ somni; Empl. Lyttæ lateri; port wine ℥x.; beef-tea.

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* Quoted by F. C. DONDERS, 'Het entoplische onderzoek tot perkenning van oogziekten.'

4th.—Pulse stronger, 120. Has had no sleep; tongue brown and dry; less pain in the chest. A limited rubbing sound over the pericardium; still complains of the shoulder. The chemosis has disappeared; the sclerotica being still dull with vessels. Pupil fixed; lens more milky; mouth not sore.—Rep. omnia; Pil. Hydrarg. gr. v. h. s.; Bellad.

5th.—I did not see him, but no particular change occurred. The opium and quinine were discontinued, and ammonia with more wine given. There had been delirium.

6th.—In the morning about nine o'clock he became quite incapable of recognizing anyone, but lay in a low muttering delirium. Pulse from 130 to 160, very feeble, and unequal. Constant profuse perspiration. Bowels since yesterday have been repeatedly moved unconsciously. A rubbing sound is still heard over the heart. The pupil is occupied by opaque milky effusion. The chemosis is gone, and there is much less redness.

He is now having wine and beef-tea every half hour, and takes it pretty well.

After this he continued delirious till his death, which took place at about ten o'clock next morning, being the 12th day of his acute disease.

Examination Twenty-seven Hours after Death.

Chest.—Lungs natural, except slight recent adhesion of the right where overlapping the pericardium. Pericardium distended with several ounces of turbid, flaky serum. The entire surface of the pericardium and heart covered with mossy fibrine, in most parts drawn into threads half an inch long, but over the pulmonary sinus of the right ventricle, and at the base of the left ventricle behind, it was thicker, and formed a closer pile. The heart was hypertrophied. One of the aortic valves was perforated by a large hole, with smooth, though irregular and tuberculated, edges. This seemed to be in part at least an old diseased condition, and was, perhaps (together with the hypertrophy), assignable to the old attack, of which mention has been made. But, besides this, there was on the semi-lunar valve, corresponding to the mitral valve, a large mass of ragged tuberculated fibrine; and, in continuation of this, down upon the flap of the mitral valve, another still larger, which almost concealed this flap. The central part of this was so ragged that the valve seemed to be destroyed, and on looking at the opposite or auricular surface, a corresponding but smaller spot, covered with fibrine, was seen. The valve was, in fact, perforated here, and the aperture occupied with loose, soft fibrine. The lining membrane of the heart, except at these points, was natural.

Abdomen.—Natural.

Head.—The arachnoid natural on its free surfaces. Underneath, on the surface of both hemispheres in the tissue of the pia mater, chiefly in the sulci, an abundance of recent pale yellow lymph. Much, also, at the base; and, in the fourth ventricle, half a drachm of creamy pus. No ulcer or abscess. Sinuses healthy. Substance of the brain healthy.

Left Eye.—All chemosis and outward redness had subsided, and the globe looked very much as the other, except that the pupil was rendered opaque by an effusion of lymph, adherent to its border, and to the capsule of the lens. The front of the iris had hardly lost any of its brilliance: the aqueous humor was clear, and the cornea transparent. On dissecting the outer surface of the eyeball, the areolar tissue contiguous to the sclerotica was found in some parts thickened, and rendered semi-transparent by the effusion which had attended the external inflammation.

The *optic nerve* was itself natural, but its sheath, for half an inch nearest to the globe, was distended with clear serum, in which floated a few nucleated cells. This effusion gave the nerve a bulbous and semi-transparent appearance. It could be made to gravitate from side to side, because it did not tightly distend the space it occupied around the nerve. It lay in the large meshes of the peculiar tissue intervening between the external layer of the sheath and the nerve.

On carefully opening the sclerotica, the *choroid* was found everywhere in contact with it, and apparently healthy. The vessels and nerves on its outer surface seemed as usual. The ciliary muscle also natural. But the moment a puncture was made in the choroid, a turbid yellow serum, with small flakes and granules, escaped. This effusion lay between the choroid and retina, which latter was thrown somewhat inwards upon the vitreous humor, and lay in folds. The quantity of fluid altogether may have been about 20 minims. It coagulated by heat. On examination under the microscope, it was seen to contain—(1), small masses of granules, very like the agglomerated granules of the retina; (2), many exudation corpuscles merging into pus-corpuscles; and (3), much amorphous, finely-granular matter. Nothing like the particles of Jacob's membrane, or fragments of them could be found in it. The cavity in which this effusion lay extended in a forward direction only as far as the *ora serrata*, in front of which the ciliary processes of the choroid adhered naturally to the vitreous body. Backwards, it did not reach the point of entrance of the optic nerve, being limited by a quantity of yellow lymph (with pus in its centre), disposed in a layer $\frac{1}{12}$th of an inch thick, uniting the choroid and retina, but most intimately adherent to the latter. The inner surface of the choroid, in contact with the effused fluid, was everywhere coated with lymph, which gave it a mottled aspect, and varied in quantity at different parts. None of the pigment seemed to be detached, and the lymph appeared to lie on the retinal surface of the choroidal epithelium. The choroidal was somewhat thickened, and tore more readily than natural. It also contained more blood than usual.

The state of the *retina* was very remarkable. When exposed to view, by the removal of the effused turbid serum already described, it appeared everywhere entire, and of its natural texture, except near the optic nerve, where, as above mentioned, a considerable mass of lymph adhered to it. The retina, however, exhibited throughout its whole extent either isolated or confluent specks of ecchymosis, which were so abundant around the optic nerve as to give to that part of it a nearly uniform crimson tint, but none existed over the extremity of the nerve, where it is seen within the globe. These ecchymoses all lay in the substance of the internal or vascular layers of the retina: seen from within they were very vivid: seen from the outside, they were fainter and bluish, being covered by the non-vascular layers or portions of them. When the retina was afterwards dried on a sheet of glass, they continued to be strikingly obvious.

I carefully examined the structure of the retina when fresh, with the view of ascertaining the changes which the inflammation might have occasioned in its elementary tissues. I could discover no trace of the elements composing Jacob's membrane, which had apparently been all dissolved or destroyed by the contact of the effused fluid. But the granular layer, the gray nervous layer with the delicate filaments contained in it, and above all, the caudate nucleated globules, were all visible, and nearly in their natural state, though falling asunder too easily. The caudate corpuscles had all the characteristic appearances of these structures elsewhere: they were small and numerous, and much more readily seen than in the fresh and healthy retina. In fact, they strewed the field of the microscope, among the rest of the debris of the membrane. Numerous exudation corpuscles were likewise intermingled.

The retina was adherent to the hyaloid as usual: no effusion separated them. On removing the retina, some little of the extravasated blood rested in points upon the surface of the hyaloid.

The *vitreous humor* was diminished in size, of rather firmer consistence than natural, and of a green straw colour. Though mostly semi-transparent, it was in some parts (viz., at the bottom of the eye, and on one side, near the lens), of an opaque yellow colour, from a denser effusion of lymph into its substance. Under the microscope it was seen to contain multitudes of minute amorphous granules, with very numerous nucleated particles, like those in the fluid effused between the choroid and retina, and evidently of inflammatory origin. These were most numerous where the opacity was densest, and on their presence the opacity manifestly depended. The hyaloid membrane was entire, and no trace of capillary vessel or red blood-corpuscle could be found in the vitreous body.

Finally, the *lens and its capsule* preserved their transparency, if we except that portion of the capsule which occupied the pupil. This part of it was rendered opaque by a film of lymph which covered it, and adhered to the margin of the pupil; and it was not a little remarkable that this lymph did not fill the posterior chamber, so as to glue the uvea to the lens, but that aqueous fluid intervened as usual between these parts, and their surfaces were free and healthy. The lymph on the capsule was limited to the area of the pupil, and by its adhesion to the border of the pupil, shut off the posterior chamber from the anterior.

Case O.—Cataract of five Years' Standing, Relieved by Spontaneous Depression of the Lens, Vision remaining.

May 24th.—Wm. Rogers, æt. 65, a hale man, has had cataract in the *right* eye for five years. The lens is tremulous, and so is the iris. The cataract is apparently hard, and in the substance of the lens only. More recently the left lens also has become opaque; but he can still see his way about, with the aid of Belladonna. Both irides are active, and there is no obvious cause to account for the cataracts. Gutt. Belladonnæ, bis die.

June 28th.—In exactly the same state. Rep. Gutt.

July 19th.—He states that his sight is greatly improved in the *right* eye, so that he can see large objects. On examination, the right lens, which was previously in the axis of the eye, is found to have disappeared from the pupil, but when the pupil is dilated, the upper border of the lens can be just discerned behind its lower edge. In fact, the cataractous lens, before partially loosened, has now dropped down, as if it had been couched. He suffers no pain or uneasiness: there is no inflammation, and with a cataract glass he can see to read a printed page.

I saw him again in August and September, when the condition remained precisely the same, and nothing was attempted on the other eye.

Case P.—Spontaneous Depression of a Cataractous Lens from Loosening of the Suspensory Ligament and Softening of the Vitreous Humor.

22nd November, 1848.—Mr. T. M., æt. 78, a very intelligent old gentleman, now in reduced circumstances, of active and regular habits, was told by Dr. ——, at 20, that he would die of consumption, and he has been ailing all his life, and has now some chronic cough.

He was near-sighted from the age of 15: wore spectacles, and his near-sight diminished. About 40, he began to have little black specks (intensely black) flying before his right eye when he looked at any light object. These continued very gradually getting worse, but did not much annoy him. They were spots and filaments flying about, but he could still "make shift" to read with this eye, till nine years ago, when, on getting up one morning, he thought the right side of his nose was black, till, on going to the glass, he was undeceived. As the day advanced, the obscurity increased: spots and a network, much more than previously, appeared, and at night he was *quite* blind, and has so continued since, with that eye (the right). This attack was not attended with any pain or appearance of inflammation. The eye looked as well as ever it did. He was attended by an eminent oculist in London.

About a twelvemonth afterwards, the lens turned of a pearl colour rather suddenly, *i.e.*, in the course of a few weeks, and when this opacity had become fully established for a week or two, having taken a blue pill over night (this is his description), the next morning he was surprised, on going to shave, to find the cataract totally gone, though of course he continued blind.

This right eye has now very much the natural appearance, except that the pupil is fixed at about one-sixth of an inch diameter. On looking, however, carefully through the pupil from above, *the upper edge of the vanished lens is perceptible behind the iris*, having sunk down in nearly the same position as was mentioned in the last case.

Such is the state of the right eye, but he comes for advice regarding the *left*. He says that eight years ago, or shortly after the total blindness of the other, a film and spots appeared in the left. The film, as it then appeared, he represents as an arched line with a circle at one end, and a small brush at the other, appearing suddenly, and extending horizontally across a surface of about two feet in width. (*See* fig. 38, *a*.) It gradually diminished, and in a few days had contracted itself into a fainter and smaller line, having the same general shape, and still terminated by a circle. Thus it still remains. (*See* fig. 38. *b*.) He has no pain, and only fears it may get worse.

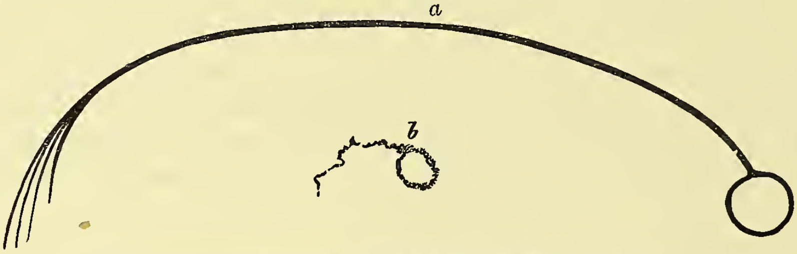

FIG. 38.—APPEARANCE OF FIXED MUSCÆ. (CASE P.)
a, First appearance. *b*, The same after eight years.

Present State of Left Eye.—With the pupil (which is active) contracted, no morbid appearance. With the pupil dilated I see a faint yellow film moving or glancing behind the lens according to the motions of the eye. The film is very small (the size of a large pin's head), with a string attached. It seems to shoot up from the lower and inner side, on any sudden turn of the eye, as far as opposite the middle of the lens, and immediately falls again when the eye is tranquil. The vitreous is of course so far fluid as to allow of this; but the tension of the globe is natural. The lens is slightly greenish, without striæ. The three images are seen, but the inverted one is not quite so distinct as it ought to be.

He sees to read very fairly with this eye.

CASE Q.—SPONTANEOUS DISLOCATION OF THE LENS INTO THE ANTERIOR CHAMBER, PROBABLY FROM PREVIOUS LOOSENING OF THE SUSPENSORY LIGAMENT.

A gentleman of middle age, tall, and of good constitution, was brought to me by a surgeon, and I gathered the following particulars of his previous history:—

Eighteen months ago, one eye was noticed by his friends to have something odd about it, different from the other; at the same time he could not see in shooting so well as before,—was "bothered," and could not tell the distance. There was no inflammation or pain, and he took no particular heed of it. He appears, however, to have had some unusual irritability of the eyes, and subsequently some trivial ophthalmia at times, till about five months ago, when after a few weeks' indisposition in the eyes, for which he took no advice, he was seized one morning on waking with severe pain in the left eye. The pain was intense, and deep seated in the globe, not in the orbit or brow. No scintillations. The pupil was widely dilated and fixed, and it was irregular, being more dilated on one side. He was actively treated for the inflammation, with leeches, blisters, and mercury, and found the eye somewhat better in the course of some weeks, but he was much reduced by the treatment. The sight, however, was nearly gone. He could see large objects, if in motion, or the window. He now came under the care of an eminent oculist, who put him on a tonic plan by which he was regaining strength, when he was overwhelmed by a sudden and severe recurrence of the inflammation in all its violence. The pain was most excruciating, deep in the orbit, and shooting into the forehead. This relapse was treated at first by dry warmth, opium and antimony, and then by calomel, which was cautiously administered, so as to touch the gums, and under this course he slowly recovered his previous position. The lens, however, was now becoming opaque in the centre. For the last several weeks he has been almost free from pain, and his health is improving.

Present State.—Left Eye.—There is some congestion, but not of large or tortuous vessels, over the sclerotica. The eye at a first glance looks like a glaucomatous eye, with secondary cataract: the pupil is widely dilated, so much so, that the iris is not easily seen at some portions of the circumference, and the central part of the lens is of a whitish, semi-opaque colour. On nearer examination, however, aided by a glass, throwing a strong light upon the organ, the lens is seen not merely advanced, but in actual contact with the cornea, and its margin very decidedly *in front of the iris.* The circumference of the lens preserves very nearly its natural transparency, and its extreme margin, in favourable lights, appears as a glistening, yellow, golden line, leaving no doubt as to its position, for both on the inner and outer sides the iris can be seen behind this bright edge. The cornea is quite clear. The eye is somewhat irritable, and readily waters. Sight almost gone. He can, however, see the fire and the window sideways, especially if they lie towards the outer side of the field. He can also see the passing of a large object between the eye and the light.

Right Eye.—Sight excellent, even for the smallest objects. Every visible part of the organ, carefully examined, appears perfectly healthy.

Though much reduced by treatment, and sallow, he thinks himself sound and substantially in good health, and of good constitution. He is not a gouty or rheumatic subject. His friends fear that the state of the eye may depend on some cerebral disease (of which, however, there is no sort of indication), and that the other eye is in jeopardy.

[Since the above was in type, the professional friend with whom I had first seen this gentleman, was so obliging as to procure from him a statement of his symptoms from the commencement of his illness, so far as he could himself relate them; and as the account is a graphic one, I append it. The italics are mine :—

" In the fall of the year 1847, while resident in London, I had a severe attack of influenza, which was attended with a *bad cough.* Shortly after this the sight first became slightly imperfect, and *a rim was observed round the pupil of the eye* by a gentleman sometimes in my company. About this time I went on the Continent (Feb., 1848); the sight apparently strengthened by the cold weather which had intervened. As soon as the warm season set in it became weaker every way, which, as *I was still free from pain,* I considered to arise from the constant view of the sands on the coast, the yellow-washed houses, the glare of the sea, and the additional glare of the sun. *By degrees it became difficult for me to identify a friend across the street,* or even the joint of meat which was necessary to be carved. No measure was taken by me to remedy the evil; being unaccustomed to illness generally for fifty-five years, I trusted to my constitution and the next winter, to bring matters right again. In October of that year (1848) a cold seemed to strike the left eye more particularly; the pupil felt tender to a fearful degree, and a great deal of redness was manifested in the corner farthest from the nostril. I shut the eye and read with the other, not yet resorting to advice. In about ten days the pupil lost part of its brightness, *looked irregularly shaped,* and, upon trying the vision, for the first time, I found it was almost gone; *there was a mist before me,* though I could just see the ground under my feet with it. I then became seriously alarmed. The next morning *intense pain* commenced, not in the head, but in the back of the eye, which lasted about twenty-four hours. Leeches having been applied, and all other remedies which the medical attendant deemed best, at the end of a month or so, the inflammation, and the congestion which followed, appeared greatly overcome. I was allowed to go out for a walk: the sight, however, *continued defective;* it was in my power to see across a room, and to discover a picture hanging on the wall at the other side, but not to distinguish the design. I could see also the surface of a table, but no small object upon it. I then paid a visit to England to obtain first-rate advice; and under the care of the oculist, and from the change of air, my strength improved very fast indeed; but there was no move for the better in the eye, nor any for the worse: *the feeling to myself was constantly that of something sticking in it.* Having incautiously exposed myself to the wet while walking, a *second inflammation* came on, which was pronounced to be rheumatism—dreadful pain for forty-eight hours; the eyeball, however, did not become so very tender in this case; the evil seemed to dwell more in the socket, extending at times (and for the first time) up the nerves of the forehead. While under treatment for this new enemy, the *sight of the eye failed altogether*, a cataract having been formed at the end of a fortnight from the commencement of this second attack. It is right, perhaps, to mention that I could distinctly perceive the fire out of one corner of the eye for some time after its formation. . . . . 16th March, 1849."]

Case R.—Loosening of the Suspensory Ligament of the Lens in both Eyes. Dislocation of one of the Lenses into the Anterior Chamber. Singular Mobility of the other, by which it falls out of the Axis of Vision in certain positions of the Head, but yet retains its transparency.

The following very remarkable, and, in some respects, I believe, unique case, is still to be seen at the hospital, and has excited the interest of many medical men:—

19th June, 1848.—John Bennett, æt. 26, of slight make, pale complexion, light hair, and blue irides, comes to-day with the left eye much inflamed, and gives the following account of himself:—Having had excellent sight with both eyes (though habitually short-sighted), he was walking quietly along the street a fortnight ago, when he found the *left eye* beginning to shoot and throb, and water very much, and his sight became affected, so that he could no longer see anything distinctly with that eye. The organ then became inflamed, and very painful, so that sleep was impossible; but as circumstances compelled him to continue his employment (of picking coffee), he did not apply for advice for a week, hoping it would get better. The pain, however, got worse, extending to the brow and forehead, and becoming quite excruciating. He then saw a surgeon, who blistered him, and surrounded the eye with ointment (probably mercurial).

Appearances.—The *left globe* is tense to the touch, and the anterior portion of the sclerotica is stretched forwards, so as to give the eyeball a conical form. All this part of the sclerotica is of a dull red colour, loaded with congested vessels, and about the eighth of an inch from the cornea the dark hue of the choroid dimly shows through. The cornea is quite bright and clear, but seems too prominent. The pupil is so widely dilated, that the iris is nowhere so much as $\frac{1}{20}$th of an inch in breadth, and the lens projects into and occupies the pupil, advancing through it, so as to fill the anterior chamber, and to be in contact with the cornea. The lens has a slight amber tint, and a narrow resplendent golden ring, apparently formed by its margin, runs round within the pupillary border of the iris. This brilliant ring is not seen all at once, but as the organ changes its position, different parts of it come into view and the same occurs if pressure be made on one side, so as to tilt the lens a little. This sparkling, glancing appearance of the margin of the lens, makes the eye look for a moment as if it contained a particle of polished metal. It seems singular that the lens does not come quite through the pupil, so as to allow the iris to contract behind it. Instead of this, the edge of the lens seems to be engaged in the pupil, or, at least, to lie with a part of its circumference immediately behind the margin of the pupil.

There being no morbid effusion in the transparent media, I was anxious to discover what amount of sight he retained in the left eye. He can distinguish the German from the Roman text on the hospital ticket, though not the individual letters, except the small capitals at the head of the paper; and these he reads better with the help of the concave glass, No. 8. He sees best at about six inches distance.

With the *right eye* he is able to read very small type, but has to place it within six inches of the eye. This eye he considers quite perfect, but, on examination, the iris is very tremulous and flat though it acts promptly and fully under the stimulus of light. From the flatness of this iris, one would fancy the lens must be gone, if he did not see so well.

Atropine was now applied to both eyes. It caused no change in the left, but widely dilated the right pupil. With the help of a taper in a dark corner, it was now easy to perceive the exact position of the lens in the right eye, viz., that it is attached only at the upper and inner part of its circumference, and swings about according to the inclination of the head, so that when he leans towards the right it comes opposite the pupil, but when towards the left it falls altogether out of the axis of the eye, and disappears on the nasal side of even the dilated pupil. In this movement its anterior surface continues to be turned nearly forward. The lens preserves its transparency.

On trying the power of the eye under these different positions of the lens, what might have been expected occurs. It is only when the lens is behind the pupil (*i.e.*, when the head is upright, or bent to the right) that he can see to read small type: the moment the head begins to incline over to the left, his sight grows confused, and he is unable to read even large letters. He describes the change to be "like the flowing of water." When, however, a magnifying glass is placed before the eye, he can distinguish even small objects once more.

On the following day, it was determined, in consultation with Mr. DALRYMPLE and Mr. DIXON, to extract the lens from the left eye, as it was obviously still causing great irritation by its displacement. The man was laid on his back, and I sat behind at his head, and with Beer's knife in the left hand made a downward section through nearly one-half of the cornea. The knife, of course, pierced the lens on its way across the anterior chamber, and a good deal of soft lenticular substance, quite transparent, escaped by the side of the knife before the section was completed. The remainder was then immediately expelled, and with it about half a drachm of aqueous non-viscid fluid, probably altered vitreous humor. This continued to trickle for half a minute, and perhaps amounted altogether to a quarter of the whole contents of the globe. The pupil was then found to have contracted to about half its previous size, and to be perfectly clear. The iris had not come at all in the way of the knife, as I had feared it might have been disposed to do. The eye was then bandaged as after ordinary extraction.

On examination, the lenticular substance was found perfectly natural, except a very slight opacity, on one side, where it had been pressed upon by the pupillary border. The capsule had escaped with it.

He now went on as favourably as possible. The pain was immediately relieved by the operation. By the 6th of July the corneal section was firmly united, and he could see to count two fingers with that eye, notwithstanding a little haze of the cornea near the section.

17th July.—The eye is better; less vascularity; no pain. Is taking quinine.

31st.—Has had pain in the eye and head. The cornea is more disposed to bulge. The front of the sclerotica is more stretched, so as to disclose the colour of the pigment of the choroid. There is also a circumscribed bulge of the sclerotica at the upper and inner part between the tendons of the recti. The cornea is clear. He can still discern the fingers.

21st Sept.—The bulging of the anterior part of the sclerotica is increased, particularly at the upper and inner side. The pigment of the choroid is visible all round the cornea, making the opaque white ciliary ligament very visible.

19th Oct.—The iris appears to have lost its contractility on the left side. The bulges of the sclerotica increase. Health better.

2nd Nov.—He stills sees a finger or piece of paper, if waved before the left eye. No irritation: no pain. The aqueous humor is clear, not serous; the left globe rather hard.

March 12th, 1849.—No change has now occurred for several months. The left eye is in a quiet state: the sclerotica is irregularly distended, but not now painful, or inclined to bulge more. There is no redness or irritation of any kind. He can see the light, and large passing objects, but nothing more.

The state of the *right* eye remains also precisely as it was when I first saw the patient, nine months ago. The lens swings about according to the position of the head: it continues transparent, and he can see very small type when the head is properly inclined.

I have now to mention one other feature in this case, which appears to be of some interest, as indicating the hereditary or constitutional origin of the detachment of the lens.

This young man mentioned to me, some time after I had extracted the lens, that one of his paternal uncles, now dead, had had "the appearance of a gold ring" in his eye, which he could make to come and go. I have a written statement from another uncle relative to this appearance, which, though imperfect, makes it not unlikely that it was a looseness of the crystalline lens, which enabled the person to throw it backwards and forwards through the pupil. I have myself seen an instance in which the patient could pass the lens through the pupil at will, without it occasioning any irritation. The lens, however, in the case was opaque.

The most singular circumstances in the history of the case I have now related, certainly seem to be—first, the perfect manner in which the right lens retains its transparency, even though detached so very much from its connexions; and secondly, the unimpared condition of the deeper-seated textures of the same eye, particularly the retina.

CASES S.—MINUTE CENTRAL SPECKS ON THE LENS AND CORNEA CORRESPONDING WITH EACH OTHER.

1. JAMES PRATT, æt. 8 months, appears to have had purulent ophthalmia after birth. At present there is an opacity (a mere point, but dense white) in the centre of the anterior surface of the capsule of the lens, in both eyes, together with a central nebulous opacity of the left cornea, and a similar one, but not quite central, of the right cornea. The opacity of the right cornea does not exactly correspond with that of the capsule, but that of the left does. The explanation of the condition in the right eye is probably this: that the lens has come into contact with the cornea, and become opaque at the point of contact, although the cornea has been chiefly inflamed at a neighbouring point. This case would seem to explain those cases of minute central capsular opacity, where the nebulous state of the cornea is no longer visible, or has not even existed.

2. CORNELIUS JUDGE, æt. 28, comes for slight ophthalmia, and is observed to have a minute opaque dot on the anterior part of the capsule of the right lens just below the centre, and a corresponding, but much fainter speck on the cornea exactly opposite. All else quite healthy. He knows nothing of the specks, as his sight is unaffected by them, and they have not been seen before. They have probably existed from infancy, and been due to the same cause as in the last case.

CASE T.—EXAMINATION OF AN EYE AFTER THE OPERATION OF SOLUTION.

The following is an account of the examination of an eye taken from an elderly man, who died in the Middlesex Hospital, in 1846, after a contused and lacerated wound of the scalp, which had caused so much swelling of the lids, that the globe had been invisible during life, but it was understood to have been long a "bad one." The eye was obligingly sent me by my friend Mr. ALEXANDER SHAW.

Globe of natural shape and texture externally. No mark of cicatrix on the external tunics. Iris natural. In the lower part of the pupil was seen an opacity apparently of the capsule, irregular, and somewhat moveable; also a more deep-seated, more flocculent, and more moveable opacity, which did not appear through the pupil, except in certain lights. On opening the eye, I found the lens nearly gone. In its place was a cavity continuous with the posterior chamber, the margin of the cavity being formed by the anterior part of the capsule, which had been largely opened, and had rolled up on all sides, retaining in some situations its transparency and other usual characters; while in other parts, especially below, it was obscured by a dense white earthy deposit. This deposit had in connexion with it a remnant of the fibrous tissue of the lens, and even traces of the superficial cells of the lens. Some of the fibres were nearly natural; others were more or less granular and broken. The posterior portion of the capsule remained, forming the bottom of the cavity, and when torn by the knife seemed perfectly natural in transparency and texture. It was also interesting to notice that the suspensory ligament of the lens was still there, and in a healthy state, holding the circumference of the capsule as usual. The ciliary muscle, also, was quite as large as usual. The vitreous humor was somewhat less firm in front than usual, and it contained in the midst of its clear transparent substance, a number of minute chalky-looking streaks or dots, the streaks being mostly directed from behind forwards, towards the back, and particularly the border, of the capsule of the lens. On examination, these consisted of minute granular particles, of an earthy nature, varying in size from mere points to $\frac{1}{1500}$th of an inch.

CASE U.—DROPSY OF POSTERIOR AQUEOUS CHAMBER, WITH SYNECHIA POSTERIOR—BULGING OF THE SCLEROTICA OVER THE CILIARY PROCESSES.

(*For a part of the notes of this case, I am indebted to my friend and former pupil,* MR. GEO. SHEPPARD.)

12th Oct., 1848.—HANNAH JONES, æt. 28, a single woman, always enjoyed good health till two years ago, when her eyes became severely inflamed from a cold, caught, as she believes, in moving into a cold and damp house. Leeches and other remedies were employed, but did not relieve the pain (which was very acute), or palliate the symptoms. The sight from the beginning of the attack was very imperfect, and in three months was gone from the right eye, and much impaired in the left. Her mouth was made sore, probably by mercury. At present she feels well, and her appetite is good.

Condition of the Eyes.—Jerking oscillations of both towards the left side. *Left.* Posterior synechia. Capsule and cornea cloudy. Can just distinguish the window bars. *Right.* The same condition, but *also* distension of the anterior part of the sclerotica, which for one-eighth of an inch from the cornea, is slate-coloured, full of dull red vessels, and presents both above and below three or four small dark spots where staphylomatous bulging of the sclerotica appears to be commencing. The dark points are about as large as pins' heads, and seem to be caused by a distension of the posterior chamber with fluid, bulging between the ciliary processes.

The remedies employed had reference to some external inflammation for which she had applied to the hospital, and which was speedily subdued. The condition of the eyes remained. She suffered from frequent dull pain, and there seemed a disposition for the distension of the right eye to increase. There were some blotches of doubtful character on the face and forehead.—Ung. Ant. P. Tart. temp.; Pil. Hyd. Chl. C. gr. v. o. n.

Nov. 9th.—*Right Eye.* I found by atropine that the border of the pupil was in all probability adherent everywhere to the capsule of the lens, for it showed no inclination to recede. As there was a persistence of the pain, and some tendency to further distension, I made a careful puncture with a grooved needle through one of the small projecting points of the sclerotica above, and drew off several drops of very nearly clear, watery fluid, which became very slightly turbid by heat (it was nearly natural aqueous humor). The operation gave no pain, and though it occasioned an immediate diminution of tension and fulness of the globe, yet it produced no change whatever in the anterior chamber, showing that there was no communication between the chambers through the pupil. No bad symptom followed this puncture, and she felt rather relieved, the pain being lessened, and even vision improved in a trifling degree on January 4th.

Feb. 1st.—Still rather improved; no pain; appearances similar. I repeated the puncture, with the same results. There occurs now, on the entrance of the needle (what occurred before, but it was not mentioned), an instantaneous injection of the vessels of the sclerotica and conjunctiva with blood, so that they look much congested, or actively inflamed, and two or three large vessels (before invisible) disclose themselves in the cornea.

This woman is still in attendance, and continues to improve a little.

CASE V.—CLOT OF BLOOD IN SERUM OCCUPYING THE AQUEOUS CHAMBERS, UNDERGOING VERY SLOW ABSORPTION DURING TWELVE MONTHS.

23rd Dec., 1847.—WM. BYRON, æt. 48, lost his left eye nineteen years ago, by a wound, for which he was treated at this hospital by the late Mr. SCOTT. The eye has been left with a transparent cornea, serum in the aqueous chambers, ossific, or earthy matter on the capsule of the lens, and enlargement of the choroidal vessels. There is also an inward squint. A fortnight ago, an effusion of blood took place into the aqueous chambers, with pain, followed by injection of the conjunctiva, and a faint zonular redness of the sclerotica. The blood has trickled from the upper part, and forms a red clot, occupying nearly one half the anterior chamber.—Emp. Lyttæ; Magn. Sulph. ℥ss. mane; Lot. Saturn.

6th Jan.—Rather more blood; pain in the eye and orbit, as well as in the head; bowels open.—Rep. Emp. Lyttæ; Sodæ c. Cinch. gr. x. t. d.

17th.—Better; sharp pain gone except at night.—Rep.

31st.—Better; very little pain. The blood remains unaltered. The coagulum presents a film descending from above, showing the point from which it has trickled, precisely as five weeks ago.

24th Feb.—Free from all bad symptoms. The blood remains precisely as before.

23rd March.—Clot slightly less. Some pain on pressure of the globe, with slight zone.—Emp. Lyttæ.

27th April.—Clot a little smaller, and paler, though still red; eye quiet.

22nd May.—Clot reddish, and semi-transparent in the upper part; pale in the lower part.

26th June.—Clot still faintly coloured at the upper part.

4th Dec., 1848.—There is still a semi-transparent mesh of fibrine at the lower part. The globe has been collapsing, and is now four-grooved by the traction of the recti muscles. The cornea is reduced in size, but still clear. The lens and iris unchanged. No pain or inconvenience.

Out Patients treated at the ROYAL LONDON OPHTHALMIC HOSPITAL, MOORFIELDS, *during the last Ten Years.*

(Extracted from the Annual Reports.)

DISEASE.	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	TOTAL OF EACH CLASS OF DISEASE.
Inflammation of the Conjunctiva, Acute and Chronic	1,451	1,686	1,454	1,625	1,825	2,226	3,189	2,128	2,396	2,468	19,848
Ditto, Catarrhal and Pustular	498	507	572	644	441	810		1,052	1,104	1,364	7,592
Ditto, Purulent (Adults)	146	6	190	172	205	24	15	6	36	20	187
Ditto, Ditto (Infant)		136				164	152	166	144	195	1,590
Ditto, Strumous	396	465	485	708	1,109	595	696	535	394	593	5,976
Inflammation of Sclerotica	79	—	103	102	—	178	158	120	139	177	1,056
Inflammation, ulcers, and opacities of the cornea	564	546	461	297	360	581	495	542	576	663	5,085
Conical cornea	2	10	5	7	—	12	4	9	5	6	60
Iritis, of various forms	75	147	126	95	103	113	94	75	166	149	1,143
Cataract, of various forms	158	165	153	184	117	151	123	133	141	206	1,531
Amaurosis, in various degrees	465	481	469	562	598	385	466	413	459	567	4,865
Inflammation of internal tunics and glaucoma	113	90	229	41	162	203	282	242	195	190	1,747
Neuralgia, Palsy of 3rd, 6th, and 7th nerves, and Strabismus	50	39	55	160	49	53	94	84	145	124	853
Inflammation of lids	105	63	120	120	83	48	102	90	150	148	1,029
Tumours of lids	74	74	108	91	123	88	79	85	81	95	898
Tinea, Lippitudo, Trichiasis	370	571	490	630	752	564	497	610	653	638	5,775
Inversion and Eversion of lids	10	12	22	22	11	21	—	21	9	16	144
Diseases of the Lacrymal apparatus	86	74	71	115	125	145	96	99	158	131	1,100
Wounds of the Eye, &c.	135	171	187	197	209	213	162	300	401	327	2,302
Fungus of the globe or its appendages	7	7	1	4	—	—	1	—	2	2	24
Tumours of the orbit	1	—	—	3	—	—	—	—	10	2	16
Miscellaneous	6	5	7	5	—	—	—	—	8	1	32
Escaped registration	100	100	200	300	300	300	300	300	300	300	2,500
Total of each year	4,891	5,355	5,528	6,085	6,572	6,874	7,005	7,010	7,672	8,382	65,353

Numerical View of the principal Operations performed at the Royal London Ophthalmic Hospital *during the last Ten Years.*

(Extracted from the Annual Reports.)

		1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	Total of each Operation.	
Cataract.	Extraction	50	53	46	71	46	57	37	23	35	33	451	Total Operations for Cataract, 983
	Depression	—	2	8	—	—	4	2	2	2	6	26	
	Solution	17	30	21	34	38	24	55	48	62	67	396	
	Congenital	4	9	6	4	10	17	13	10	20	17	110	
	Dislocated Lens	—	—	—	—	—	—	—	—	1	5	6	
	Artificial Pupil	7	19	9	14	16	6	9	7	14	22	123	
	Tumours	—	—	—	2	3	1	1	—	2	4	13	
	Pterygium	—	—	—	—	—	—	1	—	—	—	1	
	Staphyloma............	—	1	—	2	—	3	2	2	1	7	18	
	Strabismus	—	24	9	25	27	14	8	9	33	39	188	
	Miscellaneous	—	—	—	—	—	—	—	—	2	—	2	
	Entropion..............	3	6	3	2	3	—	—	3	10	19	49	
	Ditto cilia dissected out..	—	—	—	—	—	—	—	—	—	7	7	
	Globe extirpated........	1	—	—	—	2	1	—	—	—	—	4	
	Lacrymal gland removed*	1	—	—	—	—	—	—	—	—	1	1	
	New Lower Eyelid......	—	2	—	—	1	—	—	—	—	—	4	
	Fist. Lacrymalis	—	—	—	—	—	—	—	—	5	15	20	
	Total of each Year..	83	146	102	154	146	127	128	104	187	242	1,419	

* The palpebral aperture was afterwards enlarged, and an artificial pupil made in the same eye of this patient, by Mr. Dixon—an admirable example of what enlightened surgery can accomplish, in apparently a most hopeless case of blindness after an explosion of gunpowder.

X.

ON A NEW METHOD OF TREATMENT APPLICABLE TO CERTAIN CASES OF EPIPHORA.

By William Bowman, *F.R.S., Professor of Physiology and of General and Morbid Anatomy in King's College; Assistant-Surgeon to the King's College Hospital, and to the Royal London Ophthalmic Hospital.*

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The most common cause of obstruction to the flow of the tears into the nose, is inflammatory thickening of the mucous lining of the excretory channels, with accumulation of morbid secretions in the sac. But there are other causes, affecting only the puncta or canaliculi, yet equally preventing the escape of the tears, and therefore quite as annoying and as detrimental to sight. It is to certain examples of this latter kind, that the present brief communication refers.

Among these may be mentioned, *displacements* OUTWARDS *of the puncta*, generally the lower one, so that the tears no longer reach the orifice, and of course cannot enter the canal; and *closure of the puncta or canaliculi*, following mechanical injury or ulceration.

Of the displacements of the puncta, a common one is that which attends ectropion, in which the mucous membrane of the lid is thickened and often cuticular, and the tarsal margin, including that part surmounted by the punctum, becomes rounded and flattened, and the punctum thrown out of the course of the tears. The mucous lining of the canal and sac here often participates in the inflammatory thickening.

The treatment of this displacement may sometimes resolve itself wholly into that of the ectropion, and the punctum, when restored, as far as possible, to its proper direction, may, in a great measure, resume its function. And I have remarked, that in some instances of old standing ectropion, although the punctum continues displaced, yet the *stillicidium lacrymarum* gradually subsides, apparently in consequence of the diminishing sensibility of the mucous membrane as an excitant of the lacrymal secretion, under its long exposure to the air, and slow approach towards the characters of skin. Indeed, it is singular how little these patients sometimes suffer from the obstruction, except when the secretion is augmented by a cold wind, or other accidental cause.

In other cases it will happen, that after the ectropion is cured by one of the various operations in common use, the epiphora remains,—the punctum either continuing a little displaced, or at least surrounded by tumid tissue, and irreparably altered in structure. If it should appear that the sac is itself healthy, the mode of treatment presently to be described will then be applicable.

But there is another and a much simpler displacement of the punctum than that which accompanies ectropion, and which, as far as regards the arrest of the tears on the front of the eye, is even more incommodious to vision, inasmuch as the lid itself, retaining nearly its natural position, holds up the tears upon the front of the cornea, where they occasion false refractions of the light, which are not common in the epiphora of ectropion. Moreover, the secretion of tears seems to be maintained at its usual rate, and is not diminished as it often is in chronic ectropion.

A close examination is necessary to detect the cause of the epiphora in these instances. The lid is either in natural contact with the globe, or only slightly recedes from it in certain positions, as when the eye is turned upwards. The natural prominence on which the punctum is placed is, however, wanting, and, instead of it, there is a flattened or rounded cutaneous surface, on which the orifice may be discerned (though with difficulty) at a little distance from the mucous surface of the lid, and much reduced in size, being in fact never wetted by the tears, but dry and contracted.

When the situation of the orifice is discovered, a probe may be easily introduced into the sac, which is itself empty, proving the integrity of the apparatus, except as regards the position of the punctum.

There appear to be at least two causes of this displacement of the punctum: one, a slight chronic inflammation of that part of the conjunctiva lying near the punctum, producing thickening and consequent eversion—(this may exist alone or in connexion with any of the chronic ophthalmiæ, especially those of the lid),—the other, a chronic affection of the skin of the lower lid, somewhat resembling eczema, by which a general but moderate contraction of it is produced, and the punctum is drawn outwards.

It is a remarkable fact, that an extremely slight displacement outwards, will destroy the function of the lower punctum, and the following considerations are offered in explanation of it. The puncta are naturally so placed, as to be either altogether on the conjunctival aspect of the lid (as in some of the lower animals), or else (as in Man) at the very margin at which the skin and conjunctiva blend. Now skin differs from mucous membrane, in the superficial layers of the cuticle being rendered greasy by the sebaceous secretion, so that they throw off water as greased paper does; whereas, the corresponding part of mucous membrane is moist, and water adheres to it. To apply this to the eyelids, and their relation to the passage of the lacrymal fluid:—the tears have to be directed towards the puncta, and to enter these orifices; and if the skin were not greasy up to the margin of the lids, the tears would be very apt, indeed would be certain, to ooze over the tarsal margin on to the cheek. The skin of the lids is, however, exceedingly delicate and thin, and deficient in sebaceous follicles. But to supply this want, there is a great development of sebaceous glands, placed so as to pour their secretion on the margin of the lid, close upon the line of junction of the skin with the mucous membrane—on that part where there must be a constant tendency for the moisture of the mucous membrane to soak through and wet the surface of the cuticle, and yet where it is so essential to the retention of the tears, that the skin should be greasy. So that I regard the meibomian glands as existing, not for the purpose, as stated in anatomical works, of preventing the agglutination of the lids when closed (which would be no more likely to happen here, without sebaceous matter, than it is to occur between the lips of the orifice of the urethra), but for the purpose of maintaining that greasy state of the surface of the cuticle at the margin of the lid, which prevents the tears from escaping over the cheek. And I may add, that the probable use of that sebaceous gland, called the caruncle, is to throw the tears into a little pool above it, where they may be taken up by the puncta; for even the lower punctum glides above the caruncle in the winking movements of the lids. Now it appears, that the punctum, though situated on the confines of skin and mucous membrane, partakes only of the character of the latter. Its margin is always naturally moistened by the tears, and is not greasy. The mucous surface on its inner side, over which the tears approach it, is also moist and conjunctival. Now in the cases to which attention has been called, the punctum has its margin greasy and cuticular, as a consequence of its displacement and exposure, and the membrane on its inner side is similarly changed, so that the tears are prevented from coming up to it, and do not wet it, but collect in a drop at the caruncle. And if the punctum is pushed back into contact with the tears, its margin instantly throws off the moisture, and cannot be wetted by it. In some cases, a margin of $\frac{1}{60}$th of an inch of greasy membrane on the conjunctival side of the punctum, is sufficient to destroy its function.

I had seen instances of epiphora depending on the structural changes now adverted to, which resisted all treatment short of operation, and in which no operative procedure like those in common use—such as removal of a portion of mucous membrane—seemed to promise a good result, when the following case presented itself:—

A woman, æt. 43, came to be relieved of chronic ophthalmia in the left eye. The upper lid was a little deformed between the punctum and sac, owing to its having, as she said, been injured when she was eight years old. On examination, the canal was found to have been torn completely across, yet the orifices to have remained open, so that a probe introduced through the punctum, emerged near the caruncle, and could be reintroduced at the lower orifice (which was of ample size), and carried forwards into the sac. No epiphora existed.

A second case, much resembling this, occurring some time afterwards, led me to reflect whether a somewhat similar division of the lacrymal canal might not be artificially made with advantage in some inveterate examples of epiphora, so as to remedy all the inconveniences of the affection, by giving the tears a new way into the sac; for these instances seemed to show, that such an orifice in the canaliculus would not be disposed to contract, as it might have been expected to do from the analogy of other mucous ducts, while it would probably serve as well as the original punctum to convey the tears. This idea was tested in the following manner:

A young man, engaged in a warehouse in the city, had suffered for two years from constant watering of the eyes. The skin of the lower lids seemed to have been affected with chronic eczema—it was red, shining, and contracted. The lower lids at the inner canthus were a little separated from the globe, so that the puncta had not their proper backward direction, but appeared flattened and slightly everted. The tears, collecting at the inner canthus, did not touch the puncta. The upper puncta were similarly flattened, and were small and indistinct. A probe passed readily through all the puncta into the sacs.

14th Feb., 1850. Introducing a probe into the left lower punctum, I cut transversely upon it, midway between the punctum and caruncle, on the conjunctival aspect, and brought out the probe at the wound. I then slit up the canal a little way towards, but not quite up to, the punctum. This wound of course did not completely cut across the canal. It was made where the tears collected, and I hoped that it would remain open and allow them to enter the canal. But though I kept it open by separating the edges daily, and afterwards by passing a thread through the punctum into the canal, and bringing it out at the new opening, the tendency to close was so great, that on removing the thread ten days after, the wound immediately healed, and the operation proved unavailing. While the thread had remained, however, he had experienced great relief, and the tears had hardly accumulated.

On March 9th, the canal was pervious to a probe from the punctum to the sac, without obstruction. Despairing of keeping open an orifice thus made in the side of the duct, I determined to attempt the same object in another way, viz., by slitting up the canal from the punctum, for a length sufficient to carry backwards the orifice on to that part of the mucous surface, where the tears collected. This I did with a scapel, by the aid of a punctum probe introduced as a guide. On the following day, the section being adherent in its whole extent, I broke through the adhesions with a probe, and repeated the same process a few times, so as to prevent union of the margins, while the wound was healing. On the 20th, the canal was converted into a groove, and the edges showed no further disposition to adhere. The tears found their way from this groove along the remaining part of the canal into the sac, and the epiphora was almost entirely relieved. I was therefore encouraged to perform the same operation on the opposite lower lid, and was pleased to see it followed by the same satisfactory result. In July, the parts remained in exactly the same state. The epiphora was quite removed. He could pursue his employment with comfort. I have recently seen him, and found the cure satisfactory.

The experience afforded by this case, led me to reject the plan of dividing the canal transversely, as first suggested by the cases of accidental injury, and to adopt the more simple expedient of slitting it up for a short distance from the punctum, on the conjunctival aspect.

In thus destroying the punctum, I was not without some misgivings whether the tears would be taken up by the new orifice thus artificially made, at a part of the canal unprovided with the same structural arrangements which it is usual to attribute to the puncta. These fears were unfounded, for the tears entered the canal perfectly at the intermediate point. This result renders it probable, that too much importance has been given to the punctum by writers on the lacrymal apparatus, and perhaps also to that three-sided channel which is said to be formed between the margins of the lids and the globe of the eye, when the lids are closed, and which is supposed to be useful in directing the tears towards the puncta. In the Sheep, the orifices of the puncta are obliquely placed on the flat, or slightly rounded, margin of the lids, and the shape of the meibomian margin does not admit of the formation of any such triangular groove as that now alluded to. In the human subject, also, I believe it will be found, on close examination, that the edges of the lids are not so bevelled as to form a triangular groove by their apposition in front of the globe. When the lids are closed, they touch each other by the posterior or meibomian, and not by the ciliary, lip of their margin. Indeed, the position occupied by the meibomian orifices would prevent this supposed channel from playing the part usually assigned to it.

It is interesting to notice the difference in the tendency to contract manifested by the new orifice, according as it is made by a total transverse, or by a partial longitudinal division. In both cases, the divided tissues of the wall probably undergo the same kind, and most likely the same degree of contraction; but when the division is transverse, a slight contraction in the circular direction will close the canal; whereas, when it is longitudinal or oblique, a corresponding amount of contraction of the divided margin of the wall cannot close, or even much constrict, the entrance to the canal, because the wall is only divided along one side of its circumference, and the rest is left uninjured.

In fact, the analogy of the urethra guided me in this respect, where, in the able hands of my friend Mr. Fergusson, I had seen a longitudinal division of the canal from the orifice which remains after amputation, obviate that most troublesome of the results of this operation, the tendency to a stricture at the point cut across.

Both canals are allied in structure and function, as ducts of glands, and both possess in their walls that muscular element which seems to be the seat of the slow contraction, following division, to which allusion is now made.

Of course I should not advise this operation to be performed in *recent* cases of displaced puncta, nor in any in which other and milder treatment seemed available. It is well to remark, however, that no visible deformity results from it, and that no one would be aware it had been performed without an accurate examination of the part.

The following is another instance in which it has been at once successful in relieving a long-standing case of most annoying epiphora:—

A clerk to a shipping agent, æt. 57, caught slight cold in the right eye two years and a half ago, and since then the tears have always run over the cheek, especially when exposed to the cold air; at times the eye has been inflamed in a trifling degree. He has been annoyed with having to use the handkerchief constantly through the day, and his sight has been much troubled by the continual suffusion of the eye with tears.

I found the sac and lacrymal apparatus quite healthy, except that the border of the lower lid, in its inner half, was rounded and slightly flattened, so as not to fit accurately to the globe. The punctum, instead of being at the summit of the usual angular projection, lay forward on a flat surface, and was hardly visible. The skin around it was dry and cuticular, and the tears never reached it, but accumulated about the caruncle and along the margin of the lid. I passed a probe with ease through the punctum into the sac; there was no obstruction.

I slit up the canal for one-eighth of an inch, on a probe, and along the mucous aspect. Two days after he came to have the margins of the slit separated. They were adherent and filled up by lymph, which I broke through. He had experienced no relief as yet. Two days afterwards I found the slit permanently established, its margins healed, and the orifice carried backwards on the conjunctival surface for one-eighth of an inch to near the caruncle. He was greatly relieved. He had been out much in the air in the prevailing east wind the previous day, and the eye had scarcely watered at all. In the last two days the eye had been better than for two years and a half. Since this I have frequently seen him, but no further interference has been required. He seems entirely cured.

At the commencement of this communication I alluded to cases of epiphora, depending not on displaced but on *obstructed* puncta or canals. Such cases do occur every now and then, either by simple contraction or stricture of the canal, or from ulceration or accidental injury. It is remarkable that the tears do not always accumulate in these cases, either from the remaining punctum doing double duty, or from the ordinary secretion of tears being scanty. My friend Dr. Budd sent me a patient suffering from the secondary effects of concussion of the eyeball. I found, besides, that the lower canal had been divided about the middle, and that it was completely obstructed at the seat of the cicatrix. There was no stillicidium. But, in general, such a condition is attended with weeping; and in some of these cases, a modification of the operation I have described may be applicable. The proposals of MONRO and PETIT, to make new conduits, by carrying a thread, or making an incision, into the sac, have long since been forgotten. Such artificial passages close as soon as the seton or the bougie ceases to be inserted. It seems essential to the object of restoring the course of the tears, that the canaliculus should itself furnish the channel; and this can be accomplished only in those instances in which the point of obstruction is sufficiently far from the sac to allow of the canal being slit up in the interval, and through the conjunctiva. Two methods of operating offer themselves: the first, by cutting transversely across the direction of the canal, close to the obstruction, on the side towards the sac, and then slitting up the canal on a probe introduced at the wound made; the second, supposing no orifice can be found after this transverse section, by opening the sac below the tendo oculi, and then slitting up the canal, near the obstruction, on a probe run into it from the sac. The orifice of the canaliculi within the sac is so large, that I have no doubt a skilful surgeon could readily do this, if he had previously taken pains to acquaint himself with the anatomy of the parts. I have found it easy in the dead subject, but have not yet had a case in which to test its feasibility in the living. Of course the canal in these cases must be slit up through the conjunctiva, near the caruncle, or the tears could not find their way into it.

In conclusion, I would observe that there are cases of epiphora depending on obstruction of the canaliculi close to the sac, in which this operation would be out of place. The sac itself is empty; a probe passes easily along the canal from the dilated punctum, and is arrested at the entrance to the sac. If forced against the obstruction, the outer wall of the sac, with the skin over it, is moved towards the nose, and the surgeon experiences an elastic resistance; whereas, if there is no such stoppage, and the probe enters the sac, it comes into contact with the inner or osseous wall, and the skin over it is not moved. As the distance between the punctum and the inner wall of the sac is just half an inch when the canal is stretched by drawing the lid outwards, a probe covered with gold for that length will prove a useful help for determining whether the probe has actually penetrated the sac. In these cases, it will be remarked that the punctum is wetted by the tears; and it seems to me that that not uncommon dilatation of the orifice and of the canal, usually attributed to paralysis or relaxation, is, in fact, the consequence of the stricture—the tears constantly filling those parts on their way to the sac, but being unable to pass onwards.

XI.

OBSERVATIONS ON ARTIFICIAL PUPIL; WITH A DESCRIPTION OF A NEW METHOD OF OPERATING IN CERTAIN CASES.

By William Bowman, *Esq., F.R.S., Professor of Physiology in King's College, Fellow of the Royal College of Surgeons, &c.*

[*Extracted from 'The Medical Times and Gazette' of January 3rd and January 10th*, 1852.]

That delicate operation by which the surgeon opens a way for the light to the retina, when injury or disease has obstructed the natural aperture, must always be regarded with peculiar interest; for not only is it usually employed as a last resource upon a sole surviving eye already seriously damaged, but the singular variety of circumstances to which it may have to be adapted, not less than the numerous contrivances and modes of operating which have been devised in consequence, appear to give the operator much liberty of selection, and thus throw upon him a heavier responsibility. A young surgeon, with limited experience, may well be perplexed by the long and sometimes prolix accounts to be found in systematic works of the operations practised by various writers, and feel quite at a loss as to the course he should pursue in a case even of a common kind. The increased intelligence of the members of our Profession leads them more extensively than formerly to undertake the more critical operations, even those which are not urgent through present danger to life, but only by the importance of their result to the patient's future comfort or support. And, considering how momentous a thing it is to the patient submitted, probably for the first and last time, to a chance of sight, that the operation undertaken should be of the best adapted kind, and performed in the best fashion, any observations calculated, ever so little, to further these ends, can hardly be deemed superfluous.

In the remarks I am about to offer, I shall be guided chiefly by what I have seen in the cases operated on by myself. Of these I have preserved notes of about a dozen only, out of which it will be sufficient for me to insert the details of such as present any points of practical interest, or illustrate the principles which, in my opinion, ought to guide the operator. I shall endeavour to show how some of these operations might have been decidedly improved, had I been at the time in possession of the instruments now at our command, or had I then had the experience which these and other cases have since imparted. I have no wish to discuss the whole subject of artificial pupil, but only to touch upon some points of practice. By artificial pupil, in this paper, is meant not only the formation of a new pupil, but a displacement or enlargement of the natural pupil, by the art of the surgeon. To distinguish these latter under a different name, seems an unnecessary and troublesome refinement of language.

Cases for Artificial Pupil.

1. No operation is applicable, where the retina is not sensitive to light; and whether it be so or not, can be ascertained by making the light of the sun, or of a candle, fall suddenly on the eye. If the retina retain any sensibility to light, the patient will be aware of it, even though the rays should fall only on the sclerotica. For I doubt if the pigment of the human choroid, even when darkest, is ever sufficiently opaque to completely arrest the stream of light sent towards the retina through the sclerotica. Certainly a leucoma, a closed iris, and a non-osseous cataract behind, all put together, are not enough to wholly intercept the light, if it fall on the front of the eye. Light will still be distinguished from darkness if any sensibility remains in the retina. Hence it would be a mistake to operate for artificial pupil, if the patient, on such a trial, detected no light; and this notwithstanding some cases long since published, but contradictory to the general experience.

2. No operation is applicable where the original cornea has been totally destroyed, and replaced by organized lymph deposited on the front of the iris, with or without staphylomatous bulge. This may seem self-evident; yet the caution is not unnecessary, for I have seen, not one, but several patients sent to the hospital, under the notion that an artificial pupil might be made, when in fact the front of the globe was formed by an ancient cicatrix in the place of a sloughed cornea, the iris wholly adherent to the back of the cicatrix, and even the anterior part of the sclerotica slightly distended and attenuated. In some such instances the cicatrix, as well as the front of the sclerotica, is here and there semi-transparent, and the pigment is visible through it. It has the appearance of being sufficiently clear to allow of some useful sight, if only the pigment were removed. Doubt may even sometimes seem to exist whether the iris is actually adherent to the cicatrix; an aqueous chamber, however small, may be guessed at, and the retina being evidently sensitive, the surgeon may be induced to make an attempt at an artificial pupil, and to raise hopes which must lead to disappointment. In some of these cases, the ciliary ligament may be observed as an opaque, white, circular line, between the corneal and sclerotic region, which may serve to assure the surgeon that, at least, he need not try to make the pupil behind this line, even though some temptingly transparent point should present itself.

3. If, on the contrary, there is evidence of any degree of sensibility of the retina; and if the cornea is clear enough at any one point to enable the surgeon to see any of the parts that lie behind it, he may fairly attempt to make an artificial pupil at such point, provided it be otherwise indicated.

There are several preliminary questions which have received deserved attention from practical men, yet still remain more or less undecided, such as the advisability of operating on one eye while the other continues sound; whether both eyes should be operated on, supposing both have obstructed pupils; the course to be adopted under strabismus and other complications, &c. Into these it is not my intention at all to enter in the present brief paper, which relates to the rules and principles which should guide the surgeon in operating, supposing it to be determined to make some attempt to improve vision by this means in an eye of which the pupil is closed or obstructed.

The first cases to which I shall refer may all be classed together as those in which at least that portion of the cornea is opaque which lies in front of the pupil, so that the entrance of light is impeded by a central opacity of the cornea. Under this head, we may include cases in which the pupillary border of the iris is free, and those in which it adheres, in whole or in part, to the opaque cornea; cases in which the lens and its capsule are clear or opaque; as well as cases where these several conditions are variously combined. My own experience leads me to believe, that the partial adhesion or non-adhesion of the iris to the back of a leucoma, and the partial, or even total, obliteration of the pupil by such adhesions, are circumstances exceedingly unimportant in regard to the operation to be selected or its result. If the aqueous humor be natural in quality, and not serous, and if the iris retain, as it commonly does, its faculty of contraction, such cases may be operated on with almost perfect safety as regards inflammatory consequences, and according to the same general method; for notwithstanding the attenuation which the iris undergoes in the course of years, when the whole pupillary margin is permanently fixed by adhesions, this membrane does not seem to be thereby rendered more prone to inflammation. I also believe, that in the large majority of the cases now spoken of, originating, as they usually have done, in acute inflammation, advancing to partial ulceration or sloughing of the cornea, and involving the deeper parts, the iris and lens, only in a secondary, and as it were mechanical, manner, the iris long retains its healthy texture, and the lens its transparency. If it happen that the lens has fallen against the cornea on the escape of the aqueous humor, and become adherent (which is comparatively rare), then the point of its capsule touched, and that point only or chiefly, becomes opaque, while the rest of the capsule and all the body of the lens usually remains pellucid. This, at least, is the general result of the cases which I have had an opportunity of observing in London.

The central opacity of the cornea now alluded to may be leucomatous or nebulous that is, dense or faint; for the chief destruction of the corneal substance replaced by the leucoma may have been a little on one side of or below the centre, and the exact centre may have nearly recovered itself after being only infiltrated with lymph. Again, the pupil may be partly obscured by a leucoma, partly by a nebula bordering on the denser opacity. These are circumstances very important to be considered in individual cases; but as they vary infinitely, it will be desirable to establish, if possible, certain principles to aid the judgment of the surgeon meditating an operation.

In another set of cases, to which an operation for artificial pupil is applicable, the cornea is clear, and the pupil, reduced to a very small size, is adherent by its margin to the capsule of the lens, which is opaque within the pupillary area, as a consequence of iritis. Not unfrequently a small part of the margin is free; at other times it is wholly adherent. In these cases the iris is usually altered in texture, and easily lacerable. Its adhesion to the capsule may be tough, but its own tissue is readily torn by an instrument. I believe it will be generally found, that the body of the lens retains its transparency, and the capsule remains perfectly clear, except within the area of the pupil. Of this, some examples will be given. This constitutes a very strong argument for rejecting Mr. Tyrrell's operation of drilling (*i.e.*, of gradually destroying the lens by repeated and cautious "needling" through the pupil), and for attempting the formation of an artificial pupil with the maintenance of the lens, as in Cases 1, 4, and 9.

Among the cases of central leucoma, some occur in which not merely the centre but all except some small marginal part of the cornea is densely opaque; and here the surgeon has no option. He must make or draw the pupil behind the clear spot. Even should such a remaining spot not be perfectly clear, if it be sufficiently so for the surgeon himself to see any of the deeper parts (the iris or an opaque lens) through it, he may rightly proceed to operate under the same restriction.

In other instances, and I may, indeed, say in most, he is not thus limited, but is at liberty to choose between one part or another of the circumference or intermediate region, and in several he has a very large discretion, and has to consider such questions as the following:—Shall I make the pupil on the inner or the outer side, above or below? Shall I make it large or small? Should it be close to the central leucoma, even if the cornea is somewhat nebulous there? or should it be enlarged up to the very border of the cornea, where, perhaps, that membrane is quite clear? Some of these points have been well discussed by writers, though much difference of opinion remains. Others of them do not appear to have been at all fully considered.

Passing over the question as to which may be the best side (inner, outer, upper, lower) for the artificial pupil, *where choice exists*, let me confine myself to the latter questions, as to its distance from the centre of the cornea, and as to its size and shape.

1. *Importance of a Central Position for the Pupil.*—Though the rule is laid down

by more than one author, that it is better to make the pupil near the centre of the cornea, the great importance of this rule seems hardly to have been recognized, nor the grounds fully explained. Surgeons have not, perhaps, expected enough from their operations for artificial pupil, and have been too easily content if their patients obtained vision merely of large objects, when, by greater skill in their operations, they might often have enabled them to read. So important do I regard a central position, that I would rather make a pupil near the centre, behind a portion of the cornea *somewhat nebulous*, than at the margin, behind a part perfectly clear. And, as it very frequently happens that this alternative presents itself in practice, it is desirable to draw attention to it, and to ascertain the best course to pursue.

The nearly central position of the natural pupil itself suggests the reasonableness of this rule. In fact, (1) the more central the pupil, the more nearly do the rays traverse the central region of the crystalline lens, supposing it to exist (and it is the surgeon's duty always to suppose it present and transparent, unless the contrary is evident), and the more correctly do they come to a focus on the retina. (2) The more central the pupil, the more likely are the rays entering by it to fall on the central region of the retina, about the yellow spot, the seat of most perfect sight. Whereas, (3) in proportion as the pupil is made towards the margin of the cornea, these conditions are less and less fulfilled, and vision (though the same amount of light may penetrate) must be proportionally indistinct.

A slight reference to the relative anatomy of the cornea, iris, and lens, will show how unlikely it is that a fair image should result from a pencil of rays traversing a pupil made at the great or ciliary circumference of the iris. Behind the great circumference of the iris lies the circle of ciliary processes, with their tips bordering upon, and often irregularly overlapping, the margin of the lens. If they do not overlap the lens, the vitreous body lies in the interspace. In either case, rays of light entering by a pupil at the border of the cornea, must partly strike the ciliary processes; or, if within these, must pass to the retina by the side of, or through the margin of, the crystalline lens. So that not only would they probably fall on a feeble part of the nervous sheet, but they could hardly be brought to a correct focus even there.

2. *As to the Size of the Pupil.*—For the finer purposes of vision, supposing the surgeon has the option of making a pupil near the axis of the eye, it is important that the opening be *not too large.* A small pupil near the axis of the crystalline will be much more efficacious than a larger one which extends so far from the axis as to admit a part of the rays through the edge of the lens; and this will be more the case, if, as usually happens, the base or wider part of the new pupil be outwards, towards the border of the lens, and its narrower part inwards, towards its axis. If the pupil be unavoidably narrower at one part, that part should be, if possible, towards the margin of the lens. If the central part of the cornea be only nebulous,

and *so allow of some, though imperfect vision*, it will be of trifling avail to enlarge the pupil up to the margin where the cornea may be clearer. For the largeness of its size and its partial malposition will counteract any benefit derivable from the arrival of the light through a clearer medium. This will be illustrated in Cases 2, 5, 6. I shall propose a mode of slightly enlarging the pupil in such cases, while its central position is maintained.

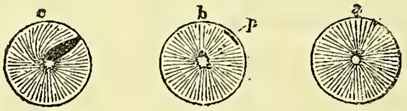
3. *As to Shape.*—This is of less consequence than position and size. But it may be remarked, that a large orifice, if narrow and much elongated, and if it take the direction of a radius in front of the lens, allows of better sight than a circular pupil of the same area. In fact, I have found a long, narrow, elliptical slit, extending from the situation of the natural pupil to the very border of the lens, sufficient to permit almost perfect vision. This is an example, as it occurs in my Case Book.

Case 1.

22nd July, 1847.—Thomas Richards, aged 37, horsekeeper. Six years ago dimness of sight came on. Three years ago he had inflammation in both eyes, apparently syphilitic iritis. *Now*, the left is without perception of light, with synechia of the whole border of the contracted pupil. The capsule is partially opaque. The right eye has also the pupil contracted to almost a point, and adherent to the capsule of the lens, except for about $\frac{1}{20}$th of an inch at its upper part. He sees very imperfectly, for the capsule of the lens is opaque within the area of the pupil. It is, however, quite clear opposite the unadherent part of the pupillary border. Under atropine the pupil dilates very slightly at this point, and he then sees better.

28th.—After atropine applied, I punctured the cornea with a cutting needle at the border above and a little to the outer side, and with Tyrrell's hook caught the free border and pulled it out. A thin strip of iris tore in a direction from the pupil towards the seat of puncture—that is, very nearly in the direction of the fibres. No hæmorrhage.

August 2.—Sees very much better. Present state of the pupil.*



a, First state, *b*, The pupil under atropine. *p*, Site of puncture of cornea. *c*, The artificial pupil.

FIG. 1.

9th.—Can see to read the newspaper very well, even the small type. No pain in the eye. The capsule and lens opposite the new pupil are perfectly clear. Possibly the pupil might be still more enlarged by dragging the lower border; but "let well alone." Possibly he might see worse with a larger pupil, and the lens might not escape opacity a second time. Dismissed.

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* This and the three following figures have been accidentally reversed in being transferred to the wood, so that they seem to belong to the opposite eye.

The surgeon's object, then, in those cases where choice is allowed, being to keep the artificial pupil as central as possible, and of moderate size, we may proceed to some general rules which should influence his selection of one kind of operation rather than another, as well as enable him to perform that which he selects in the best manner.

1. It is an important general rule, which requires to be insisted on, that that operation is the best which, while it accomplishes most completely the optical objects required, inflicts the least possible injury on the structures of the eye. This rule should, in my opinion, determine the surgeon against that violent and painful, as well as uncertain and hazardous operation, called coredialysis, *i.e.*, the tearing away the iris from its ciliary attachment, so as to open a way for the admission of light. Not only is the resulting pupil too large, and its wide part in the wrong position, close to the border of the cornea, in front of the ciliary processes, and the edge of the lens, and thus optically objectionable; but the operation lacerates the nerves and vessels entering the iris, is attended with hæmorrhage and perhaps sickness, with some risk of subsequent inflammation. I hope it will be altogether discarded from practice.

This rule also indicates that the operation should be performed through the cornea rather than through the sclerotica. In the former way the cornea and the iris only are interfered with; in the latter, the sclerotica, the choroid, the vitreous humor, and the lens where it exists. The risk of hæmorrhage and subsequent inflammation are thus much less in the corneal operation.

It also implies the importance of performing the operation by a very small wound—by a puncture rather than an incision, and certainly rather than by the recent method of GUEPIN, who punches out a circular piece of the cornea, making a hole into which the iris may prolapse, requiring subsequent cauterization with the nitrate of silver.*

2. It is desirable that the wound should be so made in the cornea that the opacity it may leave shall not afterwards interfere with the passage of light to the new pupil. To avoid this opacity some surgeons have preferred the operation by the sclerotica; and when the alternative appeared to lie between risking a nebula in front of the new pupil, and the possible inconveniences of perforating the sclerotica and choroid, perhaps it was well to prefer the latter. It was also well to prefer the latter, when the modes of operating through the cornea too often (as with Maunoir's scissors) imposed the necessity of a large incision in that part, and therefore involved the chance of an extensive opacity. But as I hope it can be shown, that either the

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* *See* DESMARRES, 'Mal. des Yeux,' p. 470.

corneal wound need not be made close to the new pupil, or, if close, that a mere puncture will accomplish all that is desired, the alternative disappears, and the corneal operation may in most, if not all instances, be preferred.

3. It is also important, in a procedure of so much nicety, that the eye should be at the perfect command of the surgeon, and that he should continue to see clearly every step until the whole is completed. Where the patient has not perfect self-command, chloroform acts admirably, and is better than forceps or hooks for maintaining the steadiness of the globe. As to the last clause, it implies the great importance of limiting the escape of the aqueous humor while the necessary manipulations on the iris are in progress. This will be explained further down.

Particular Operations for Artificial Pupil.

Keeping in view these rules, we may advance to the consideration of the particular operations employed. I shall only here advert to such as seem most advisable, and point out how they may be modified so as best to accord with the principles laid down.

The operation almost exclusively practised at present in cases of corneal opacity, at the Moorfields Hospital, where more than 11,000 patients are annually treated, is that of excision, as modified by the late surgeon of this hospital, Mr. Tyrrell. I shall briefly describe that operation, and then venture to speak of its merits and defects, and how it may be usefully adapted to the cases to which it may seem to be still applicable.

It consists in first puncturing the margin of the cornea with a broad cutting needle at the point towards which the artificial pupil is to be drawn. If the original pupil is quite obliterated by adhesion to the cornea, the needle is pushed onwards in the aqueous chamber so as to pierce the iris close to the cornea. The needle being withdrawn, the small blunt hook, known as Tyrrell's hook, is introduced, seizes the margin of the pupil if it exist (or the margin of the aperture in the iris just made by the needle), and being semi-rotated on its axis, draws it out through the corneal wound. The prolapsed iris is then cut off with scissors.

The advantages of this operation are great. It inflicts very little injury on the eye, and is very seldom followed by any serious inflammation. The corneal puncture may be always made so small and so near to the sclerotica, as not to leave a nebula prejudicial to vision. And, *if the iris remains entangled in the corneal wound*, and becomes adherent to it, the pupil is often of moderate size, and either elliptical or triangular, with its apex at the margin of the cornea. In such cases vision is often rendered very good. The lens, also, need never be damaged and made cataractous by the blunt hook,—a most important circumstance.

This operation, however, seems to me to be liable to serious disadvantages, among which are the following :—The aqueous humor generally escapes before the critical period when the iris is seized by the hook, and thus the procedure may be interrupted or fail. This escape occurs always to some extent when the needle is withdrawn. It occurs also, and to a greater extent, the instant the hook is introduced, for the stem of the hook does not fill up the corneal wound, and unless the operator is very prompt and dexterous, the whole of the humor is pretty sure to run off before he has seized the pupillary margin. The iris then comes in contact with the cornea, probably wraps over the hook and conceals it from view, making the seizure of the iris at the right point somewhat of guesswork. Another disadvantage is the large and irregular pupil apt to result if the iris should slip back through the corneal wound. I have been told, that in Mr. Tyrrell's own cases the iris frequently failed to become adherent to the corneal puncture, and I think that no operator can at all insure the iris remaining entangled in it after the operation is over. Hence the object is marred. For Tyrrell's hook having its recurved portion an eighth of an inch long, seizes a large extent of the iris, and this quantity is increased by the twist given by the half turn which is required in order to withdraw the instrument adroitly through the cornea. The iris, when drawn out, is puckered and folded at the wound through which it passes, and, as has been said, forms the apex of the new pupil, if it remains fixed in the cornea. But if it recedes from this wound, after a portion has been cut off by the scissors, the folds at once open out widely in the aqueous chamber, giving a jagged margin to the pupil, which then becomes much too large, and its widest part often towards the ciliary border exposing the ciliary processes, or at least the margin of the lens. If the prolapsed iris have not been removed by the scissors, and it recede, of course the eye returns to the condition it was in before the operation. The two following cases illustrate some of these remarks :—

Case 2.

Benjamin Hummerston, aged 26, was admitted on the 2nd of April, 1849. Left eye lost after small-pox in childhood. Had severe inflammation in the right eye eight months ago. Vision was destroyed at first, but gradually recovered to a slight extent. He comes with a view to having an artificial pupil made. There is a leucoma covering

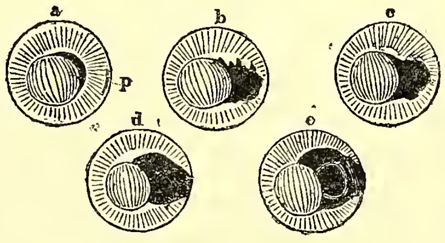

FIG. 2.

the pupil, except when it is dilated, by shading the eye; its outer edge then appears, and improves his sight a little. (Fig. 2, *a.*) In the centre of the leucoma is a dark speck, where the iris had prolapsed, and where the pupillary margin is now partially adherent. I enlarged the pupil outwards, with Tyrrell's hook, in the usual way, and snipped off the protruding iris. The iris almost immediately became disengaged from the corneal puncture, and opened out, as seen at *b.* No pain or inflammation ensued. Three days afterwards, the irregularities of the margin had smoothed down, the pupil remaining much too large (*c*). His vision was very imperfect, though improved a little. He could not distinguish objects at a distance of two yards, but could see large letters when held very near the eye. On the 27th of April he returned to the country, but little improved. The pupil was still larger than before. (Fig. 2, *d.*)

He returned on the 8th of April, 1850. Sight was too imperfect to work with. I found that he could see much more clearly by placing before the pupil an opaque plate, perforated by a pin hole, or, still better, by a horizontal narrow slit. He could then see faces, and even read large type, thus proving how much better a smaller pupil would have been. I ordered a slit plate for him from HAWES.

June 25.—The plate is of much use, both indoors and out; it, however, strains the eye, if used long at once. No inflammation. Health very good.

April, 1851.—Amendment continued till three months ago, when he had pain, and shining, moving appearances lasting a month, and recurring even now. Sight is much impaired. The aqueous is turbid, and the lens is seen opaque and moving behind the pupil. On July 22nd, the eye was sufficiently recovered to allow of the needle being used to the lens. On Nov. 25th, the lens was quite absorbed, but a web of capsule stretched across the pupil, one band especially across the centre of it. I introduced Luer's scissors on the upper and inner side, and bringing their blades up to the pupil, cut across this band at each end, so as to clear the central part of the pupil. No inflammation followed. He was afterwards able to see better, but not so well as before the cataract formed. It is probable that the retina and vitreous are diseased.

CASE 3.

Feb., 1851.—JOHN GRIFFITH JONES, aged 45, able seaman, sent over by Captain BATHURST from the Bay of Honduras, where he has been stationed twenty-six years, under the following circumstances:—He had lost the left eye, in 1831, by a shot. Globe collapsed. The right eye was perfect till June, 1850, when it became inflamed. It was without sight till November. He was salivated and actively treated. In November he began to see a little, and was sent over for the purpose of having something done in England.

Present State, Feb. 15.—Right cornea semi-opaque and uneven on the surface in the central third, opposite the pupil, and also above. At the sides and below, it is clear and natural. When the pupil is dilated by shading the eye with the hand, he can just see the large letters "on them 'buses." I dilated the pupil with atropine, and found he could then see minion type through a pin-hole in a card. As all ophthalmia had subsided, I decided on making an artificial pupil downwards, and a very little outwards, in order that he might afterwards use the pin-hole. Fearing to enlarge the pupil too much, I determined to operate as follows:—I made the puncture near, but not close to, the margin of the cornea, at the lower and outer part,—introduced Tyrrell's hook, caught the border of the pupil,—taking care to engage it but very little in the hook,—and withdrawing it, left the iris in the puncture, by disengaging the hook, without, as usual, cutting off the iris with the scissors. The pupil seemed all I could wish.

The lids were closed, and the eye looked at three days after, all being quiet; but, to my disappointment, I found the iris had slipped back into the aqueous chamber, and had resumed its natural place. The pupil was more contracted than before, but was active; there was no inflammation at all. The corneal puncture was closed, and the aqueous restored.

After the lapse of a week, his time being limited, I again operated as follows on the 27th. I punctured the cornea close to the old place, but a little higher, for I feared, if I passed through the former puncture, the wound might not readily heal. As the needle was piercing the cornea, the old puncture gave way, and the aqueous escaped, so that great care was required in passing the needle completely in, not to wound the iris or lens. The hook was then introduced, the pupillary border caught, and withdrawn as usual. A small piece was now cut off.

Three days after, all was perfectly quiet. The iris remained attached to the cornea, not only to the last puncture, but also to the previous one, and a pupil resulted which was quite what I expected. (*See* fig. 3.) He could now see much better than before, could walk without help along the crowded streets, and, with the help of a pin-hole, could see very small type. No inflammation followed, and, the lens remaining transparent, he sailed on the 14th March. He had already found that he could see to read medium type by closing the eyelid a little; and I observed that in doing so the pupil was partially covered.

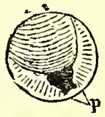

FIG. 3.

From the issue of some previous cases similar to this, in which I thought that the patients might have had more sight restored, had the pupil been kept smaller and more central, I tried the plan of making the puncture in the cornea less near the margin, so as to limit the pupil outwards, and hoped, by more carefully restricting the size of the corneal puncture, to insure the retention of the iris in the wound. If this last expectation had been fulfilled, it is probable that the sight would have been much superior to that otherwise resulting; but the following case convinced me that there was no certainty of securing this adhesion of the iris to the wound through which it had been prolapsed, and that, if it did retreat when the puncture had been thus made at some distance within the corneal margin, the nebula probably resulting must stand in front of the pupil, and thus add to its other defects. The case, though one of posterior synechia, bears exactly on the point in question. The subject of it was one of the Chinese at the junk, then at Blackwall. Notes were kept by my friend Mr. Lynch.

Case 4.

April 5, 1849.—Allauck, aged 24, has been in England eighteen months. About eight months ago contracted syphilis, and was treated at the Dreadnought Hospital ship. Four months ago had syphilitic iritis, and when it had continued some time, he was again taken to the Dreadnought. Though the most skilful treatment was employed, it ended in the destruction of the left eye, and only the very partial recovery of the right. Its pupil was much contracted, and adherent by lymph to the crystalline capsule, except at one point at the outer side. The capsule in the area of the pupil was opaque, but when atropine was applied, the free portion of the pupil dilated a little, and showed that the lens behind it was quite clear. He could then also see better. Without atropine his vision was very imperfect. He could with difficulty see two fingers.

27th.—I operated for artificial pupil. After atropine, the small free margin was caught by Tyrrell's hook, drawn out, and a piece cut off. The puncture was made about a tenth of an inch within the margin of the cornea, in order to limit the pupil outwards. (*See* fig. 4, *a*, *p*.)

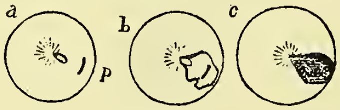

FIG. 4.

On the 28th, the pupil was as in fig. 4, *b*. The iris had receded, had opened out, and the puncture was in front of it.

On the 29th, blood was effused into the aqueous chambers, filling them, and obscuring everything. A blister and purge. Being much depressed in spirits, he was allowed to return to the junk at his urgent request.

May 17th.—Comes with the blood all absorbed, and a good clear pupil. (Fig. 4, *c*.) The cicatrix of the puncture is, however, slightly nebulous, and in front of the pupil. Still he can see to read and write Chinese characters, and has inscribed his name in the Case Book.

I shall now adduce two cases illustrative of a very common class, in which the operation with Tyrrell's hook is very defective, and the evils of the large eccentric pupil it is so apt to make are displayed. I give them in order that the same operation may not be repeated in similar instances, but that another shortly to be mentioned may be substituted. In these cases the whole, or a considerable portion of the pupil, had a nebula in front of it, through which some degree of vision was possible, and when the pupil was dilated with atropine, or even by shading the eye, vision was much improved; for not only was more light admitted, but the pupil extended either beyond the nebula, or behind a part less dense. Hence an enlargement of the pupil was indicated (for the position in life of the poor precludes their having constant recourse to atropine), and that with Tyrrell's hook seemed at that time the most simple and suitable.

Case 5.

April 8, 1850.—John Scott, aged 39, labourer, having had the right eye lost after birth, came with acute inflammation and onyx of the left cornea, for which I treated him in the usual way.

On the 31st May the inflammation had quite disappeared, and there was a leucoma in front of the lower half of the left pupil, and above this a nebula. (*See* fig. 5, *a.*) The iris was adherent below to the leucoma. Sight was improved by atropine, under which the pupil surmounted the nebula. The cornea being quite clear on the outer side, I determined to give him a chance of improvement by enlarging the pupil outwards. This was done as usual: the operation was perfectly simple. A little blood lay afterwards in the anterior chamber, but in two days this was cleared away, and the eye was recovered.

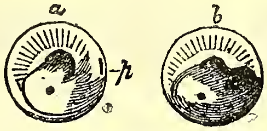

FIG. 5.

On June 8, the condition was as in fig. 5, *b*. It is interesting to note the following observations as to the result on vision of this operation:—

On the 29th June, he could see better through the central part of the pupil than through the lateral part, when they were alternately covered by a card, although the nebula was in front of the centre, and the margin was clear; and yet I found that the operation had decidedly improved his sight. It had done so, by allowing the upper border of the pupil to rise much more freely behind the nebula when the eye was shaded than it could do before.

This note is appended in the Case Book:—"I will think of slitting the edge of the old pupil above, so as to enlarge it centrally and above, it being evident, that a central pupil behind a nebula is better than a marginal one behind clear cornea."

Case 6.

June 6, 1850.—John Russell, aged 25, has leucoma in each eye from variola in childhood. In the right it is central and large, and the rest of the cornea is nebulous. In the left it is at the lower part of the cornea, but a nebula extends from it upwards in front of the whole pupil. (Fig. 6, *a.*) The sides of the cornea are clear. There is a central speck on the capsule of the lens, seen even through the nebula. His sight with this eye is very imperfect, but improves under atropine, which dilates the pupil beyond the margin of the nebula. (Fig. 6, *b.*)

I enlarged the pupil downwards and outwards as represented at *c.* The cutting needle was introduced close to the margin of the cornea, and close to the leucoma. With Tyrrell's hook I drew out the iris where it was stretching up to a point of adhesion to the leucoma. Its texture being brittle, it tore. I did not cut off any. I introduced the hook three or four times to endeavour to extract more, and succeeded partially, leaving some entangled in the corneal puncture.

10th.—No inflammation followed. (Pupil shown in fig. 6, *c.*) This patient was very little improved. He could see better through the central part when the pupil was dilated with atropine than through the lateral part of the pupil when the central part was covered.

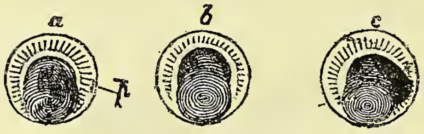

FIG. 6.

The reason of the little benefit done by the operation in these cases seems evidently to be this, that the nebula in front of the natural pupil allowed still of vision through that part, so that the pupil, as altered by the operation, was a very large one, including the old central and the new marginal part, and was thus extremely defective, according to the principles laid down above.

These cases especially impressed me with the importance of a central position for the pupil, and determined me to endeavour to find some means of enlarging the natural pupil to a limited extent in a suitable direction, still keeping it as central as possible, rather than of drawing it out with Tyrrell's hook to the margin of the cornea. I was, therefore, much pleased to see the small scissors which M. Luer exhibited here last summer* (viz., at the first "Great Exhibition," 1851); and it immediately occurred to me, that this admirable instrument was likely to fulfil some important indications in a superior degree to any other yet invented.

These scissors consist of delicate blades, about a quarter of an inch long, expanding from a stem which is moved up and down a canula of the size of a cataract-needle by means of a spring in the handle. When the spring is pressed, the scissors are closed by being drawn partly into the canula; and when it is relaxed, they open by being protruded by a spiral wire concealed in the handle. The blades of the scissors are pointed, and one of them projects beyond the other and has a cutting-back edge; so that it is capable of piercing the cornea or sclerotica, and allowing the whole instrument (closed) to be introduced within the chambers of the eye. When within, the blades may be opened and made to cut iris or capsule of the lens, by means of the spring in the handle. The canula and scissors are so adapted in size to each other, that the canula quite fills up the wound which the scissors make in the cornea, and thus the aqueous humor is prevented from escaping while the scissors are at work within.

With the view of adapting these scissors more perfectly to the operation for artificial pupil which I meditated, viz., to snip the border of the pupil at a given point without risking the lens—I requested M. Luer to shorten the blades by almost one-half, and to make the shorter of the two blades blunt-pointed instead of sharp-pointed. I required the blades shorter in order that they might work in a smaller space, and one point blunt, in order that it might be passed behind the iris, and not puncture the capsule if it touched it. With this modified instrument, I operated as follows in the next case that presented itself.

Case 7.

October 3, 1851.—Edward Bush, aged 36, lost the left eye by a blow three years ago; four months ago had severe inflammation with sloughing of the cornea in the right eye. At present there is a dense leucoma occupying the greater part of the right cornea. The iris is barely visible below, and the leucoma extends over the centre, obscuring the pupil. When the eye is shaded so as to dilate the pupil, it rises a little above the leucoma, and his sight is considerably improved. Still, the cornea is slightly hazy above the leucoma, to nearly its upper margin. The lens appear to be *in situ*, and perfectly clear. The lower edge of the pupil adheres to the leucoma.

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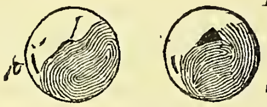
* These and other analogous instruments may be obtained at Weiss's.

The patient being placed as usual on his back, I introduced the scissors at the outer side of the cornea, where it was very nebulous, and pushed them on as far as the existing pupil, where it lay almost, but not quite, obscured by the leucoma, for atropine had been applied. The shorter, blunt-pointed blade of the scissors was then passed behind the upper border of the pupil, and the long sharp-pointed blade in front of the iris; and the spring being pressed, the blades closed and cut the upper margin of the pupil to the extent of about $\frac{1}{16}$th of an inch. Though the hinder blade must have touched the lens, this was not wounded. No blood flowed to discolour the aqueous humor; and the man, sitting up, could at once see the trees and distant houses through the window. No inflammation ensued and he returned to the country.



p, Site of puncture of cornea. The line extending from the pupil shows the incision by the scissors, but is rather too long.

The second diagram represents the pupil after the first operation.

FIG. 7.

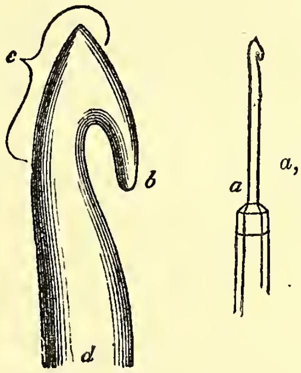
Early in November he came back for inspection, and his sight continued much improved; but as he stated that he saw more distinctly when the eye was shaded, and it was found that the pupil enlarged slightly upwards when that took place, I resolved to repeat the operation, and to divide the iris at the same point, but to a slightly greater extent, so as to place the pupil permanently in the condition in which it was thus found to serve most efficiently the purposes of vision. This was accordingly done, and the pupil enlarged by a second cut. The operation was exceedingly simple, the aqueous not escaping, and no bleeding attended it. He left the hospital two days after. A minute strip of iris remained between the two cuts which had been made in it. When this shrinks, the man's sight will doubtless be much improved.

No inflammation or opacity of the lens followed this second operation, which shows how much may be done with safety with this delicate instrument.

These scissors may be used also with advantage through the cornea to make an opening in the iris when the pupil is obliterated by prolapse, after the extraction of cataract; and, indeed, I think, that while they enable us to make the pupil as central as possible, to define its extent, and to save the lens when present, and all this with a mere puncture of the cornea, they must supplant altogether the iris scissors of Maunoir, which require a large incision in the cornea, do not enable the surgeon to limit the pupil as he desires, and are very apt to wound the lens, induce cataract, and mar the elegant results of the operation as produced by the canula scissors.

Mr. TYRRELL employed his hook to make an artificial pupil in some cases of conical cornea, an operation which has been abandoned probably by most surgeons, on account of the inconveniences already detailed as attendant on the use of this instrument, inconveniences which must have been even greater where the pupillary border was entirely free, than where it was partially adherent to a leucoma. I should not now hesitate, in a suitable case of conical cornea, to introduce the canula scissors, and to incise the pupillary border at such a point as to enlarge the pupil by the resulting gaping of the incision, opposite a part of the cornea near the centre, which was more fitted than the irregular apex of the cone to transmit a true refraction to the lens and retina.

I would also recommend the use of these scissors to enlarge the pupil where the cornea is thickly nebulous, not leucomatous, and where vision is much improved by dilatation of the pupil. The constant use of atropine greatly improves sight. By snipping the pupillary border at two or three points, and to a slight extent, the pupil is permanently enlarged, but at the same time kept central. The operator need not hazard the lens, and the danger of inflammation is trivial. Such cases are numerous, and have not admitted of relief by any operation hitherto devised. The operation would be performed much as in Case 7. The scissors introduced below might snip the outer and inner margin by being turned to each in succession.



a, Size of needle-hook. *b*, Blunt hook (enlarged view). *c*, Cutting edge. *d*, Stem.

FIG. 8.

I may add, that these scissors are also extremely useful in cutting across bands of opaque tough capsule, which are often very hard to deal with by the ordinary cutting needle. This use of them is exemplified in Case 2.

Notwithstanding what has been above advanced as to the disadvantages of the operation with Tyrrell's hook under ordinary circumstances, there will remain certain cases in which some such instrument will be useful. For example, where the whole cornea is leucomatous except one small marginal spot, the pupil must be made behind this spot, and the smallness of the spot will limit the pupil, so that a large opening in the iris would be of little consequence. Again, in cases like those above related (Cases 1 and 4), where, with synechia posterior, a small point of the pupillary border remains free, it will be desirable to hook it and draw it outwards, so as to make the elliptical pupil, which has been shown to be so serviceable. Here the iris readily tears rather than the adhesion to the capsule should give way, and the hook answers well; nor could the scissors be employed.

But, to obviate the defects already alluded to, even in cases to which a hook may still be applicable, I have contrived the following needle-hook, which has been made for me by Mr. WEISS. (*See* Fig. 8.)

Of the general size of Tyrrell's hook, it is sharp and flattened at the point, and the stem is cylindrical, and of such a size as exactly to occupy the corneal wound, and effectually prevent the escape of the aqueous humor during the operation. There is a slit on one margin near the point, running up towards the point, and making the terminal part of the instrument a hook as well as a needle. The cutting edge extends from the point as far as the shoulder on the side opposite the slit; while, on the other side, or that which must be turned towards the lens in seizing the pupillary border, the edge is cutting only close to the point, and the convex part of the hook, that might touch the capsule, is blunt.

With this instrument, no previous puncture with a needle is requisite. The needle-hook introduces itself, retains the aqueous humor, and brings out the iris, while it is calculated to insure the safety of the lens as much, I believe, as Tyrrell's hook. In fact, the retention of the aqueous humor, by maintaining the exact position of the iris and lens during the surgeon's manipulations, must, itself, go far to enable him to avoid wounding the lens.

The slit may be made of different depths in different instruments, so as to entangle more or less of the iris as desired; and the recess of the slit is cutting in one, for those cases in which it is desirable to slit up the iris from the pupillary border rather than to withdraw or remove a portion with the scissors. In the latter cases, when the iris has been slit up as far as necessary, say one-half of the distance from the pupillary to the ciliary margin, the hook may be disengaged and withdrawn, leaving the pupil much limited in the direction of the ciliary margin.

If it should happen to seem desirable to re-introduce the hook after a first attempt to withdraw a portion of iris, Tyrrell's hook will still be the best instrument, and may be used as a supplementary aid to the needle-hook, which manifestly is not adapted for introduction a second time by the same aperture, after escape of the aqueous.

In conclusion, I have pleasure in appending a very interesting case, which has been placed at my disposal by my friend Mr. W. W. COOPER, in which he very ingeniously made an excellent pupil by means of another of the new French instruments. It is as follows:—

SAMUEL HILL, of Derby, aged 45, a stout, florid man, by occupation a porter, was attacked in February, 1850, with iritis of both eyes, which ultimately led to the closure of the pupils by deposit of lymph. They were contracted to the size of pins' heads, and the iris was much stretched in each. In the lower part of the left pupil there was a clear point, but so small as to be scarcely perceptible.

This man became a patient at the North London Eye Infirmary, and was operated on by Mr. White Cooper, on the 25th of last October.

The right eye was selected as being the worst, and the operation performed was as follows :—A small incision was made with Jäger's double-edged knife through the outer margin of the cornea, a little below the median line; the aqueous humor escaped, but the iris did not bulge into the wound. A pair of extremely fine forceps (made by Luer after the pattern of Charriere) were then introduced, with the blades closed; when in front of the pupil the blades were opened by means of a spring, and a few fibres of the iris at the external border of the pupil, seized, and very gently drawn out of the wound. The rent thus made in the tense membrane, immediately dilated, forming a good-sized oval pupil. (*See* Fig. 9.) Nothing more was required; not a drop of blood appeared, and the eye was closed and bound up.

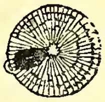


FIG. 9.

The patient recovered without a bad symptom, and returned home to Derby on the twelfth day after the operation, having regained good vision.

This is probably the first time in which these forceps, intended for the removal of opaque portions of capsule, were used for the formation of an artificial pupil. The wound in the cornea did not exceed an eighth of an inch in size, for the peculiar construction of the forceps enabled them to be expanded when in the anterior chamber. The blades grasped the iris where it was firmly bound down to the capsule of the lens, but without injury to that delicate membrane; and the small portion was withdrawn without any other part of the iris having been touched, much less bruised, a point of great importance in such cases.

XII.

CANULA-SCISSORS FOR THE EYE.

By William Bowman, *Esq., F.R.S., Professor of Physiology in King's College, Fellow of the Royal College of Surgeons, &c.*

[*From 'The Medical Times and Gazette,' January* 31*st*, 1852, *p.* 108.]

In a recent paper on artificial pupil, I spoke of "the small scissors which M. Luer exhibited here last summer" (p. 247), but was not aware of what has just been pointed out to me by my friend, Mr. Wilde, of Dublin, that a similar instrument was described by him in your Journal of December 7th, 1850, under the name of "a new scissors for the removal of opaque capsules and false membranes from the chambers of the eye." Mr. Wilde states there, that he took advantage of the principle of the very beautiful instrument lately invented by M. Charriere, viz., the canula-forceps, in which the blades are forceps-blades, and conceived the idea of making them scissor-blades, which idea the instrument-maker has carried out. For this idea I think the Profession is much indebted to Mr. Wilde, and I hasten to say so. I should have been grieved if, through any inadvertence of mine, that eminent ophthalmic surgeon had been deprived of any share of the merit so justly due to him. He proposed the scissors for the division of fragments of opaque capsule, or false membrane, which so often elude the cutting needle; and also says, "possibly this instrument, or some modification of it, may be useful in performing the operation for artificial pupil, or in detaching portions of the iris from the back of the cornea, &c. I have been induced by M. Charriere to give this early notice of the instrument, otherwise I should have waited until I had had practical experience of its value and working." Thus the merit of suggesting the possibility of the application of this instrument, or some modification of it, to the operation for artificial pupil belongs incontestably to Mr. Wilde.

Mr. Wilde says, "when introduced through the cornea, an opening should first be made for it with a flat needle or the point of an extraction knife." Hence the canula-scissors he proposed were not self-penetrating, while those shown me by M. Luer are so; a great advantage. For it might prove difficult to introduce the scissors through a wound in the cornea, by which the aqueous humor might have previously escaped, thus bringing the iris into contact with the cornea; whereas, when the scissors make the wound, and their canula fills it, the aqueous humor is retained while the blades are at work. I mention this, because it illustrates the steps by which inventions are perfected. Who made the scissors self-penetrating is of some consequence, as all merit should be acknowledged. Probably, it may have been M. Charriere, perhaps M. Luer—I do not know; but without this improvement I do not think the instrument would have been so serviceable as it is. My own further suggestions were, to have the blades even shorter than before, so as to work in the small space to which we are often limited, where an artificial pupil is to be made, and to have the shorter blade blunt-pointed, so that it could be pushed behind the iris without risk of wounding the lens. For these suggestions, I desire to claim no credit, as they naturally occurred to me when my mind was engaged on the subject.

I shall only add, that the object of my paper was to draw attention to the great importance of certain principles to be kept in view by surgeons about to operate for artificial pupil, and to show by examples how existing modes of operating might be advantageously modified. The question interesting to the Profession and to humanity, is, how can we most safely operate so as to form the most useful pupil?

XIII.

ON THE USE OF TWO NEEDLES AT ONCE IN CERTAIN OPERATIONS ON THE EYE, ESPECIALLY IN THOSE FOR CAPSULAR CATARACT AND ARTIFICIAL PUPIL.

By William Bowman, *F.R.S., Fellow of the Royal College of Surgeons, Assistant-Surgeon to the King's College Hospital, and the Royal London Ophthalmic Hospital, Moorfields.*

[*From Vol. XXXVI of the 'Medico-Chirurgical Transactions,' published by the Royal Medical and Chirurgical Society of London.*]

Received April 12th.—Read May 24th, 1853.

I am desirous of describing a new mode of operating applicable to many cases of closed or obstructed pupil, and which will be found, I think, a useful addition to the resources of ophthalmic surgery.

It consists in the simultaneous employment of two needles, introduced at different points through the outer coat, and made to act in concert upon false membranes, opaque capsule, or iris, or even on the lens itself under certain circumstances.

Several advantages attend this mode of operating. Opaque portions of capsule are often very tough, and being attached to the suspensory ligament of the lens, or to the pupillary border of the iris, these extensile structures readily allow the opaque membrane to recede before the needle, rather than be torn or cut through, and the surgeon vainly sweeps the membrane before the instrument from side to side at the risk of serious injury and consecutive inflammation of the ciliary processes or iris.

Now if two needles are brought to bear on the opaque capsule from different sides of the cornea or sclerotica, each furnishes the other with a point of resistance, and the capsule may be torn open or cut at pleasure, in almost any direction, and generally without any drag on the neighbouring vascular structures.

If the capsule is membraniform, the needles are made to puncture it close together from opposite sides, and their points are then separated so as to tear it open. If it is of a cobweb form they enter one of its meshes, and are used in the same way. If it is a tight band stretched across the pupil, the needles cannot always be so successfully employed, at least, unless the surgeon has acquired some dexterity in handling them. It is then possible to twist one of them round and round the band, and so to get a kind of hold upon it, in case it should on trial have proved too tough to yield to the needles made to cross over it from opposite sides. In one instance only have I been foiled in the attempt to divide such a band with the two needles.

The needles usually act perfectly if passed through any convenient opposite points of the margin of the cornea, the pupil being always, where possible, dilated by atropine. The injury inflicted on the organ by this mode of procedure is thus reduced to a minimum, the simple needle punctures through the cornea being in themselves trivial, and no other structure being interfered with except the capsule or membrane, which it is the object of the operation to deal with. It is but seldom desirable, for the sake of the manipulations, that one of the needles should be entered through the sclerotica. Of course, in thus using two needles at once, in knife-and-fork fashion, the operator's hands are both engaged, and the lids must be held open for him either by an assistant, or, what I much prefer, by the wire speculum. This leaves the globe completely at his command, with room for all the movements of the needles.

A great advantage of this mode of operating is, that it may be at once proceeded to in any case, where, on trial, a single needle is found to be insufficient to effect the laceration of an obstructing membrane. Sometimes, and indeed generally, the toughness of an opaque capsule is obvious to the experienced eye; but at others, the needle alone can afford a correct intimation of its texture; and if, where the surgeon suspects that he may meet with resistance, he begins by using the wire speculum, and provides two needles in case of need, he can make trial with one of them first in the ordinary way, and proceed to the operation now described, by inserting the second needle should he find it necessary to do so. He is thus able exactly to adapt the extent of his interference to the demand of each particular case, and this without deferring the major operation to a future time.

The needles to be used should be ordinary cataract-needles, the stem cylindrical, and of a size to easily occupy the corneal puncture, and allow of free movement while retaining the aqueous humor. If the stem does not move freely in the puncture, the cornea is apt to be *creased*, and the view of the interior of the eye to be thereby obscured. They may be made to cut more or less near the point. It is well in some cases, that one or both should be slightly curved at the point. It is better to insert one first down to the membrane; this holds the globe, and the surgeon sees more deliberately what he is doing. The second may then be carefully introduced so as to act in the way previously determined on in the operator's mind; for he should consider in what direction the membrane may be best torn through in each case before commencing, since on this will depend his choice of the points at which to puncture the cornea or sclerotica. In general it is better to hold one needle fixed while the other is moved, as it is not easy, without practice, to attend accurately to the movements of both at once. The temper of the needles should of course be such that if they chance to touch, there may be no risk of their points breaking. To avoid the chance of inadvertently penetrating further than desirable with one of them, whilst the attention is engaged upon the other, the stem of the needles may be made thicker from the handle up to within half an inch of the point ("stop-needle"); in no case is it necessary to enter the instrument beyond half an inch in depth.

The patient should be laid on his back, and chloroform may be exhibited if he thinks it worth while.

In the preceding remarks, I have had chiefly in view the application of the double-needle-operation to tough capsular and membranous cataracts. Many surgeons of great experience are averse from meddling with such cases if they can possibly avoid it, that is, if the patient already enjoys a moderate amount of sight, or if the opposite eye is sound. They are deterred by the fear of exciting dangerous, or, at least, troublesome inflammation, by the injury liable to be done to the iris, ciliary processes, or even (through the vitreous humor) to the retina, in the attempt to tear through the opaque capsule. But I believe that by operating in the way I propose, this danger may be almost entirely avoided, by the power it confers of strictly limiting the injury to the punctures of the cornea and the capsule itself.

The operation is also suitable to cases of false membrane obstructing the pupil where the iris is adherent to the lens, and where it may seem desirable to get rid of the lens by solution. In several instances of closed pupil I have employed, in the first instance, Mr. TYRRELL's operation of drilling, so as to destroy the body of the lens, and afterwards, when a dense membrane alone remained, I have used the two needles to tear open this membrane and restore the pupil in its natural situation. To do this with a single needle is often exceedingly difficult, owing to the toughness of the membrane, and the extensibility, or even the soft and rotten state, of the iris, altered in texture by inflammation. A single needle passed through the pupil may often be pushed widely from side to side, under such circumstances, without dividing the false membrane; and sometimes the iris has been separated from the ciliary attachment in the effort, or such inflammation has followed its stretching, as to close again the pupil which may have been opened, and thus to nullify the whole proceeding. A second needle in the pupil affords the requisite point of resistance, and the slightest force will now suffice to establish the aperture, without the least strain upon the tissue of the iris.

I have further made use of the double-needle-operation to form an artificial pupil in some cases, chiefly those following extraction of cataract, or where the lens, from any cause, has been removed. With two cutting needles inserted into the iris at the same point, and then diverged, a new pupil may be produced with great precision, and with accurate regard both to size and situation: it may be kept of moderate dimensions, and be placed in the most central position possible; conditions of which I have elsewhere endeavoured to signalise the importance.*

I might adduce many examples in illustration of the above observations. The method I advocate has been extensively tested during the last six months by several of my colleagues, at the Moorfields Hospital, as well as by myself, both there and in private practice; and it has been frequently remarked in the operating theatre, by those who have witnessed the operations performed, that results have been obtained by means of it which could not have been otherwise arrived at. Very frequently have two needles been able to effect the division or removal of false membranes, where one only had a moment before proved unavailing. I therefore feel justified in speaking of this method as one enabling the surgeon to deal with the important morbid states in question more effectively as well as more safely than has hitherto been possible.

I will conclude this brief paper with a few remarks on the canula-instruments recently introduced for operations on opaque capsules, and which the double-needle-operation is calculated, in my opinion, in most of such cases to supersede, though these instruments will still be highly available in certain operations for artificial pupil. All must admire the delicacy and beauty of the canula-forceps and the canula-scissors, in their several modifications of self-penetrating, blunt-pointed, &c. With great nicety in their construction and management, and with a little practice, they may be manipulated so as to effect all that has been expected of them. But the canula-forceps act by forcibly dragging the dense and tough capsule from its attachments, and of course they must endanger the vascular parts to which the capsule is connected, in precise proportion to the firmness of these attachments; and though the immediate result, in the clearing of the pupil, is admirable, and often followed by but trivial inflammation, yet violent and even destructive ophthalmitis occasionally ensues, particularly where the eye has previously suffered, and where it is usually of most essential importance to avoid re-exciting it. As respects the removal of the fragments of capsule out of the organ, no advantage attends it, except the security it gives that they can never again obstruct the pupil; but fresh inflammation, induced by the removal, may lead to a new membranous cataract; and, on the other hand, portions of capsule divided by the double-needle-operation, and receding behind the pupil, are as much out of the course of the light as if they were actually withdrawn from the globe, and they can occasion no irritation.

The canula-scissors of my friend, Mr. Wilde, inflict less injury on the vascular parts than the canula-forceps, because they cut across the capsule without dragging on its attachments ; but they require room for the blades to work in, and it is therefore essential that the aqueous humor should be retained, which is not always easy, unless they are introduced through the sclerotica. They require a largish orifice to enter by, and they cannot readily cut the capsule except in the direction in which they have been introduced, so that they seem chiefly applicable to cases in which a single and very tough band stretches across the pupil. To divide this, I believe they are still the best instruments.

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* 'Medical Times,' Jan., 1852.

[In using canula-instruments special antiseptic precautions are to be observed.—W. B.]

XIV.

ON THE TREATMENT OF LACRYMAL OBSTRUCTIONS.

By Mr. Bowman.

‘*Ophthalmic Hospital Reports,*’ *Vol. I*, *pp.* 10 *to* 20, *October*, 1857.

In the ‘Medical and Chirurgical Transactions’ for the year 1851, is a paper on a new method of treating certain cases of Epiphora, in which I showed the advantages of laying open the lacrymal puncta, on the side towards the conjunctiva, when they had become everted and dry, thus carrying backwards the orifice to a point where the tears could enter the canal. Of this method I shall only say that subsequent experience has confirmed my opinion, and rendered this the established practice.

Both before and since the above date, my attention has been largely given to the treatment of lacrymal obstructions on account of their frequency, their intractable and obstinate nature, and the exceedingly unsatisfactory results of the modes of treatment in common use. Indeed, from the peculiar and complex construction of the parts concerned, from their small size and tortuous disposition, there is no subject in the whole range of Surgery which has been more troublesome to our predecessors, or that more invites the study of those who would fain leave science more advanced than they found it.

As if to sum up the difficulties which surround the cure, or even relief, of the more serious cases of chronic obstructions of the sac, there has arisen within a few years the practice of laying it open from top to bottom, and altogether destroying it with the heated iron, a plan said to be effectual, but, if so, by the more complete closure and obliteration of the organ diseased.

I would now refer to cases of chronic inflammation of the sac, with mucus or pus, or both, at once or at different times occupying its cavity, and either impacted there, or discharging more or less freely under pressure, either forwards into the nose by the nasal duct, or backwards on to the eye through one or both of the canaliculi.

The various expedients hitherto in use for relieving this condition, *without inserting a style* or tube through the skin into the sac and down the nasal duct, to be worn for a certain time, may be said to have signally failed, though occasionally attended by partial or temporary benefit. Such expedients are leeches, blisters, injections of warm water or various astringents, the frequent passing of such hair probes as the puncta will admit, together with suitable constitutional treatment. The inflammation in those cases often varies in intensity, subsiding and re-appearing, and such subsidiary means do often add to comfort. The patient, too, by frequently pressing out the mucus, may often succeed in abating his annoyance and keeping it in check. But, nevertheless, it almost always happens that the distress continues, and is very apt, sooner or later, to end in abscess and fistula.

The insertion of a style, or tube, through an opening made in front of the sac below the tendo oculi, has been the last and common resource in obstinate cases, where the disease has worn out the patience of the sufferer and the surgeon. It is an expedient so objectionable in itself, as never to be resorted to till the last moment. It is unsightly, especially in females; it is painful, and the patient has constantly to wipe away the discharge escaping by the orifice. The puncture made to admit the style, is also frequently followed by the formation of an abscess outside the sac, spreading under the orbicularis muscle, and apt to grow into that serious complication a sinuous ulcer, for the cure of which, free division, and sometimes excision, of the overlying skin is necessary. During several years in which I was in the habit of using the style, I studied its inconveniences, and devised a remedy for some of them. In particular I found it desirable to make the first opening large enough to allow of the free escape of the discharges from the sac by the side of the neck of the style; for if the orifice were made too small, an abscess between the sac and the skin was very prone to follow. But this large preliminary opening was apt to allow the head of the style to bury itself in the sac, an inconvenience not always obviated by a thread secured by plaster to the forehead, and I therefore came to use, in the first instance, a style so long as to rest on the floor of the nose, while the head stood just outside the orifice in the skin. The length was adapted in each case, to the requisite depth of the parts ascertained by a probe, the styles being made of extreme length, and shortened at the moment, by cutting pliers, and the lower end smoothed on a hone. As the inflammation following the puncture subsided, and the orifice gradually contracted with the progress of the cure, the length of the style was from time to time diminished, so as to keep the head upon the skin. But I have now, in ordinary cases, altogether abandoned the use of the style inserted by the skin. It is found necessary, by those who use the style, to continue it for periods varying from six weeks to six months, and some patients seem to wear it permanently. If the condition of the parts allows of its removal, the orifice either heals or remains fistulous. If it heals, and a relapse of the sac-inflammation occurs (no unusual thing), the whole process has to be repeated: a fistulous opening is a continual annoyance.

The expedient—to which some surgeons have been led—of introducing a style or tube by the skin, and burying it in the sac or nasal duct, healing the skin over it, has been an attempt to escape from the annoyances of the external opening, but such metallic substances usually act sooner or later as foreign bodies, causing abscess, and the utmost difficulty in extracting the offending cause. Of this I have had several examples.

The inconveniences of the style are indeed such, that it is seldom resorted to till the last moment, when pus has formed in the sac, or perhaps abscess is threatening or has burst, the surgeon and patient being almost equally unwilling to have recourse to it, and wasting their time on the temporizing and palliative measures first alluded to, which seldom effect a cure, or do more than keep the annoyance in check.

Influenced by these considerations, and having in view the perfectly innocent result of laying open the punctum where it was everted, I began as early as 1851, to slit it up as far as the caruncle, in *all* cases of lacrymal obstruction, and have since, by degrees, arrived at a method of treating almost all such obstructions without opening the skin at all. In fact, I have found it possible to treat the greater number of cases, mechanically, through the upper or lower canaliculus thus opened at the punctum, by passing probes, of suitable size, downwards into the nose, thus commanding the entire length of the passages, and not being limited, as by the old method of the style, to occlusions of the nasal duct. In this way I have arrived at some facts not previously ascertained, as to the history of these obstructions, and have adapted the treatment to them respectively. I have avoided the inconveniences of the opening in the skin, and have established, at the very commencement of the treatment, a permanent opening, unseen, and attended by no inconvenience, through which the use of the treatment by probes can, at any time, be at once resumed in the event of relapses.

In the course of my investigations I have kept constantly in view the analogy of these obstructions with those of the urinary passages. They are in many respects closely allied and mutually illustrative, and I have borrowed from our experience of urethral strictures some hints, applicable to the treatment of those of the tear-ducts.

Before the proposal to slit up the punctum, some anatomists may have been aware that the canaliculi were capacious ducts, large enough to admit an ordinary probe; but certainly surgeons took no account of that important fact. They have been syringed and probes have been passed down them (I had done it a hundred times myself); but the instruments employed were only such minute ones as the puncta would admit, namely, of the size of a horse-hair. It may be even true that such probes may have been passed into the nose, but their effect, even then, can have been only such as would be produced on a urethral stricture if the surgeon were restricted to the use of the smallest urethral bougie. They may have passed the stricture, but can have done little to dilate or cure it.

When I first began to slit up the puncta, I became aware that the canaliculi were naturally capacious enough to admit a probe of one-twentieth of an inch diameter or more; and finding, not unfrequently, that strictures existed in the canaliculi, sometimes about the middle, but oftener close to the sac, I had a series of probes constructed, reaching from a fine hair probe (No. 1) to one of one-twentieth of an inch diameter (No. 6). For convenience in use I have three probes, the six ends of which give the six sizes required, and the larger of which are so bent as to facilitate their passage through the nasal ducts, as hereafter to be noticed.

In the great majority of cases of sac-obstruction, a simple epiphora precedes, for a considerable period, the more inflammatory stages: there is regurgitation of only tears at first, afterwards of mucus, and of pus; the two latter being often rather sudden in their appearance, and often following immediately on a cold or catarrh, or some stomach derangement. The moment the secretions from the lining of the sac become too thick to escape easily, either through the canaliculi or nasal duct, they appear at once to aggravate the inflammation by mechanical distension; and I was early led to assign much benefit to the opening of the punctum, merely on the ground of the greatly increased facility with which the discharge could then escape on to the eye, either spontaneously or on slight pressure. The punctum, too, having, no doubt, the attributes of a sphincter, is often highly sensitive, and its lips turgid and angry, when the passages are inflamed; and great immediate relief to the whole disease seems often to follow its division—much, perhaps, of the same kind as that which follows the division of the sphincter ani in irritable fissure of the rectum.

The punctum is most conveniently slit up as follows:—The patient sits in a chair and leans the head against the chest of the surgeon, who stands behind and bends over. For dividing, *e.g.*, the left lower punctum, the ring finger of the left hand is placed on the skin over the lower edge of the orbit, and fixes it there, while tightening or relaxing the lower canal by a sliding movement of the skin upon the bone—the punctum being at the same time everted. The right hand now inserts the No. 1 probe while the canal is relaxed, and then places the probe between the index finger and thumb of the left hand, which holds it in the canal, and further everts the punctum by turning the probe downwards on the cheek, while the ring finger stretches and fixes the canal by a sliding movement of the skin outwards, toward the malar bone. A fine, sharp-pointed knife held in the right hand, now slits up the canal on the everted conjunctival aspect, from the punctum as far as the caruncle, and the probe is raised on its point out of the canal, to make sure that the edge of the punctum has not escaped division. Care should be taken not to slope this little incision obliquely through the tissues it severs, as there is then a broader surface exposed, and greater risk of reunion by the first intention. To avoid this, it is in all cases desirable to pass a probe across the line of incision, on each of the few ensuing days, to break through adhesions if they form, and to secure patency. [Should it be inconvenient for the surgeon thus to watch the case, a little powdered diacetate of lead, applied to the divided tissues as soon as bleeding has ceased, usually suffices for the same object. It is remarkable in some instances how prone is such reunion to occur, especially along the canalicular lining, and up to the very punctum itself, the tendency to it continuing for days, or even weeks.—W. B.] If the punctum is slit up when already inflamed and discharging pus, there is much less disposition to this primary union than when it is slit for simple epiphora.

Having slit up one or both puncta, as may seem desirable, the canals are at once probed to ascertain whether they are of full size. Where the fluids of the sac regurgitate towards the eye there is usually no contraction that may not be at once overcome by a full-sized probe (No. 6); but it is well to have noted beforehand, whether regurgitation occurs from *both* puncta, and in the first instance to be content, in ordinary cases, with slitting up the lower punctum, inasmuch as this usually suffices for the cure, and it is through this that the passages can be most conveniently probed in their whole extent, down to the nose.*

In examining the canal for stricture some experience and tact are requisite to avoid errors, just as in the examination of urethral strictures. The instrument should be handled very delicately, and the canal held by the surgeon in the same way as when the puncta have to be slit, and he should, of course, have in his mind's eye at the moment, the anatomy of the parts with which he is dealing—no *force* should be used. If No. 6 will not pass, No. 4 or No. 2 may be tried; and if these fail, it is better to postpone further proceedings till a few days have elapsed and the slit in the canal is permanently established. Speaking loosely of the general result of a great number of cases, I may say that I have not found any stricture in the canals in more than one-fourth, and that the common situation of the stricture† has been close to the sac—less frequently about the middle part of the canal. The stricture of the middle parts is commonly in old cases, where there is rigid thickening of the coats, and where probing by instruments, successively larger, suffices to dilate it. The canal should be stretched lengthwise as the probe reaches the obstruction, as its passage is thereby facilitated—for it is easy to fold the canal before the point of the probe. The greatest care is to be taken to proceed gently and not too rapidly, as, if a false passage be formed and the wall of the canal torn, the injured part is liable to become more rigidly occluded.

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* [I came afterwards to prefer the upper, if only one, as allowing the probe to enter the nostril with less twisting of the canalicular region. I, however, came eventually more and more to open both canaliculi at the first sitting, in almost all cases, and to probe as far as necessary, chiefly along the upper.—W.B.]

† [In this fourth.—W.B.]

If the exploratory probe is arrested at the point where the canals coalesce and join the sac, the fact may be known by noticing that the skin near the tendo oculi is moved when the probe is moved, and an elastic resistance is experienced; whereas, if the probe has entered the sac, it hits against the inner bony wall, and the skin is motionless. Where the sac is not distended, attention to this point is particularly necessary, and it is also requisite that the canal should be held on the stretch by the finger on the cheek, otherwise the outer wall of the sac may be pressed against the inner and give a wrong indication, for the opposite walls are very near each other. Care must also be taken, when an obstacle is encountered, to turn the point of the probe in different directions, urging it gently forward in each, for otherwise it may merely be caught in a fold of membrane at the orifice to the sac. If there is decided obstruction still, the probe may be forced here, and if it does not then at once pass into the sac (and particularly if, the sac being distended, there is no regurgitation by the canal), I have recourse to the *canula-lancet* (described and figured by me in the 'Annales d'Oculistique' of 1855, tom. xxxiv. p. 141), and, after piercing the obstruction, immediately pass the largest sized probe (No. 6). Such strictures of the canals, when once they admit a No. 6 probe, are treated by its repeated use at suitable intervals, in conjunction with the treatment of the passages below, and therefore they need not be further separately dwelt upon.

I have now to describe the subsequent steps of the treatment. In all cases I prefer to explore the nasal duct by pushing down the No. 6 probe into the nostril. When the sac discharges pus or mucus, this always has to done again and again, in order thoroughly to open the duct, and even where the sac is not inflamed, it is satisfactory to have passed the probe once.

The passage of a probe or style in the old method, through an orifice in the skin, is not always an easy task. There is frequently a firm closure of the nasal duct, requiring the use of considerable force to overcome it, and a surgeon without experience is apt to be timid or to make pressure in a false direction. In fact, with the old style or probe, which was always straight, it was often impossible to find the lower orifice of the sac, and the rude force exerted was apt to make the end of the style scrape the surface of the bone, and detach the membrane from it. When the probe is introduced in my method, from the canal, it enters the sac *behind* the tendo oculi, and is in a better position for *finding*, as it were, the orifice of the nasal duct. But to make this proceeding as easy as possible, I have my larger probes (Nos. 5 and 6, which are the only ones used for this purpose) *slightly* curved at each end in two different directions within the terminal inch or inch and half, while the central part (or that held by the finger and thumb) is straight, and they are cylindrical in their whole length. The effect of this is that when the probe is inserted into the sac, and brought into a vertical position, a slight rotation of it on its long axis makes the lower point, which is in search of the orifice of the duct, describe a small circle; and by slightly varying the inclination of the probe and making gentle pressure at the same time, with slight rotation, the point never fails to enter the duct. The right and left probes have opposite curves, to suit the inclination of the duct.

The probe is known to have entered the nostril by the depth to which it has entered compared with the external position of the nostril, and also by its coming in contact with the floor of the nose. It is allowed to remain there for a few minutes, or is immediately withdrawn according to circumstances.

In any ordinary case of chronic inflammation of the sac, I consider the cure well begun, and often half accomplished, as soon as a full-sized probe has thus passed into the nose through the whole course of the natural channels. To repeat the probing is a very simple process, the enlarged punctum being always ready to admit it, and the proceeding being usually more easy each time it is practised. I repeat the probing every day, every other day, every three or four days, or every week, according to the progress of the cure and accidental circumstances. It now usually becomes at once easy for the patient to press mucus or pus from the sac, as it is secreted, both by the canaliculus and nasal duct; he is enjoined to do this very frequently, hot fomentations being used if required. It is common to find in a few days, that no more pus is formed, and in a few weeks that mucus ceases to accumulate. In many cases the relief to the epiphora is immediate, and the patients are made at once much more comfortable, losing all that distress that has been occasioned by the distension of the cavity of the sac, and the congestion of its lining membrane.

Rather more than a year ago, I contrived a mode of inserting a style by the canaliculus, and leaving it for a certain time in the passages, in order to open them on the principle of the old style. The style was made to taper rather suddenly at one end, and it was bent at about a right angle, so that the thick part should be placed vertically in the sac and nasal duct, and the thin part horizontally in the canal. The length of the thick part was adapted in each case by the surgeon, so as to extend from the point at which the canal enters the sac downwards as far as the floor of the nostril, on which it rested, being thereby prevented from falling too low and burying itself out of sight. The proper length was ascertained previously by measurement by a probe. The horizontal part was in like manner adapted to reach to a point of the canal midway between the caruncle and the punctum, and a bend was given to it, making it lie exactly within the canal, concealed from view in the channel formed by the slitting up of that passage. The material was silver, and the ends, after being cut to the requisite length, were carefully rounded, and the thin one tipped with sealing-wax.

These *bent styles*, when suitably adjusted, I found could be generally worn with very little inconvenience for a few days, and admitted of being readily removed and re-inserted, and I still employ them when the stricture is dense and obstinate, or when a rapid opening of it is required. But they sometimes occasion trouble, and become a source of irritation, and they may even produce ulceration of a portion of the canal if badly fitted, or if left in too long, as, for example, when the patient has absented himself during the treatment.

I, therefore, prefer to treat the obstructions in almost all cases by the intermittent use of the probe, as already described, and especially as the results by that method are so satisfactory. I do not recommend the bent styles for general adoption.

In speaking of the rapid relief or cure of cases thus treated, I must not omit to say that of course I do not neglect such general and local means as are familiar to all, and which were at first enumerated. They are useful as aids, but without the surgical interference would be unavailing. Nor do I wish to have it thought that all cases get well at the same rapid rate, or that relapses never occur. Unfortunately these cases of obstructed ducts generally occur in subjects more or less debilitated, scrofulous, or otherwise unhealthy, and there may be complications of disease of neighbouring parts, or of the Schneiderian membrane. But all these inconveniences appertain to the old method even more than to mine, the advantage of which is, as I conceive, that it effects the opening of the passages in the most simple way conceivable, and with the least possible interference with the natural structures. It, therefore, seems preferable, not merely in itself, but also inasmuch as it is able to be employed in the required degree and extent, and in that only; at a period of the disease however early, and under all contingencies of relapse; and, therefore, if generally adopted, it may be expected to alleviate the severity and diminish the number of these distressing affections, which have been hitherto hardly less troublesome to the surgeon than to the patient.

I must also state that there are cases of an aggravated nature, which have passed beyond the stage at which the above simple treatment is available, where abscess has formed, where the sac is enormously dilated and thickened, where bone is diseased, where styles have been previously worn and fistulous orifices exist. My hope is, that such cases will gradually now become less frequent.

[On the subject of the foregoing, see a valuable paper by Mr. T. Pridgin Teale, Jun., M.A. Oxon., in 'Med. Times and Gazette,' Jan. 7th, 1860.—W. B.]

POSTSCRIPT TO THE PAPER ON "LACRYMAL OBSTRUCTIONS" IN THE LAST NUMBER.

By Mr. Bowman.

'*Ophthalmic Hospital Reports,*' *Vol. I, p.* 88, *January,* 1858.

To facilitate the slitting up of the punctum, a minute director may be substituted with advantage for the No. 1 probe, as described at page 264. It has been made by Mr. Weiss, at the suggestion of Mr. Critchett, and consists of steel coated with gold by the electrotype process. It is sufficiently thick in the stem to give it firmness, and one end is reduced to a very fine size, and grooved to within a line of the extremity, which is of the size of a No. 1 probe. It is used in the way described at page 264.

I may take this opportunity of saying once again, how cautious it is necessary to be in the manipulations upon the canaliculi, particularly when they are the seat of stricture, and how desirable to proceed gradually from one step to another, not neglecting subsidiary points of treatment. I may also state that when one canaliculus is strictured and the other open, I prefer to proceed with the treatment of the sac and nasal duct through the open canaliculus, leaving the other alone; for a stricture of one canaliculus is often of itself insufficient to occasion any epiphora, and if the sac-inflammation and the stricture of the nasal duct can be cured by probes conveyed through the open canaliculus, the patient is relieved effectually, even should the other remain strictured, which it often does not. In such instances, however, I always slit up both puncta.

XV.

ON CONICAL CORNEA AND ITS TREATMENT BY OPERATION.

By William Bowman, *in* '*The Ophthalmic Hospital Reports,*' *October*, 1859, *Vol. II, pp.* 154–167.

Conical cornea is a thinning and bulging of that structure in its middle region, coming on imperceptibly, and altering or destroying the natural focus of the eye. Up to this time its anatomical conditions have hardly been fully ascertained, and though many optical and operative correctives have been applied to improve vision, occasionally with some success, there is room for further efforts in the same direction.

I.—Its Anatomy.

The following is the only case in which I have had any opportunity of accurate examination :—A young lady had had from infancy a slight prominence of one eye, and at 13 it had so increased as to excite alarm. A firm elastic tumor could be felt above the outer canthus, projecting the eye, which saw well. The tumor was punctured, fluid let out, and the eye receded, but in two years the eye had become once more prominent, and had now assumed the state known as conical cornea, remaining otherwise healthy. In three months more the tumor had thrust the globe more forwards, everting the upper lid, and almost destroying sight, apparently by pressing upon and stretching the optic nerve. The conicity of the cornea was very considerable, and, as is usual in such cases, was accompanied by opacity at the irregular apex of the cone. It was now necessary to remove, if possible, the whole disease. In company with Professor Syme I first excised the globe, then, partly through the space obtained, and partly by an incision below the brow, I succeeded in completely removing a very large sebaceous cyst, with bony plates in its wall, which was adherent to the very bottom of the orbit. The removal of a V-shaped portion of the lid then corrected the ectropion. The recovery was most satisfactory, the young lady now wearing an artificial eye.

Mr. Hulke gave me the following account of an examination I requested him to make of the cornea.

Note on the Perfectly Fresh Cornea.

The cone is a very prominent one, and is confined to the central region. The apex is nebulous, but elsewhere the cornea is quite transparent. Its surface is polished, not facetted. The aqueous humor, iris, and lens, are normal.

Microscopic Examination.

A section was carried through the line of the ora serrata, so as to remove the anterior ring of the sclerotic, with the ciliary processes, the iris and cornea entire; this portion was then pinned out flat on a piece of wood, with the iris downwards, and dried. Various sections were then made, and moistened with water or acetic acid.

The central conical nebulous portion was much thinner than the transparent periphery of the cornea, where the curve was natural. This thinning began at the base of the cone, and progressively increased towards the apex, where it reached its maximum. (Fig. 1.) At this point the mean depth of several vertical sections was only one-third of that of the peripheral region. The continuity of the anterior elastic lamina was perfect, but upon the cone this structure was much thinner than elsewhere and wrinkled; it was underlaid by a stratum of crowded, elongated club-like nuclei

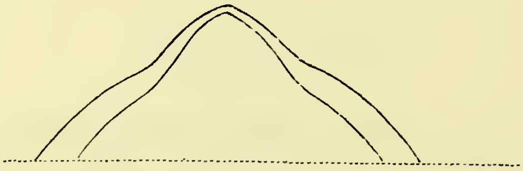

FIG. 1.

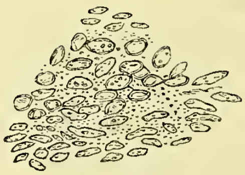

FIG. 2.

(fig. 3), and beneath these the normal lamellar tissue was replaced by a web of caudate and nuclear fibres (fig. 5), amongst the meshes of which clusters of large oval and fusiform cells were packed. (Fig. 2.) The structure of the transparent peripheral region was perfectly normal (fig. 4), and at the base of the cone there was a gradual transition from the healthy to the diseased tissue, the interlamellar corpuscles becoming more plentiful, branched and drawn out into fibres, which in many instances coalesced with those from neighbouring corpuscles. (Fig. 5.) The posterior elastic lamina, and the epithelium both on the front and on the back of the cornea were unchanged.

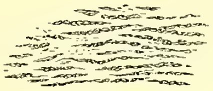

FIG. 3.

"The changes I have described," adds Mr. Hulke, "were confined to the lamellar tissue of the cornea and the anterior elastic lamina. The substitution of a web of nuclear fibres and cells for the regular lamination of the cornea, explains the nebulosity of the cone, and the liability to bulge."

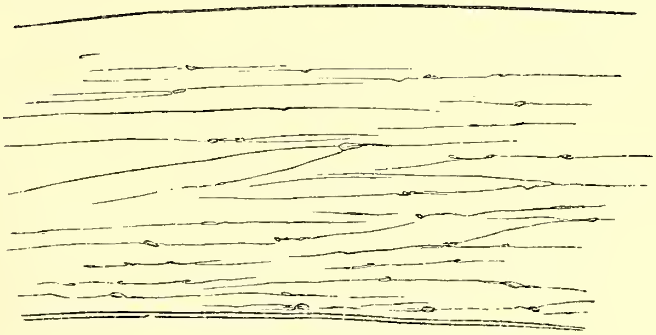

FIG. 4.

The above account is quite conformable with what might have been anticipated from such an examination, and sets at rest doubts which may have existed as to the condition of the bulging tissue. It may remain a question in what degree the cell-growth in the opaque part may be regarded as a cause, and how far as an effect, of the stretching.

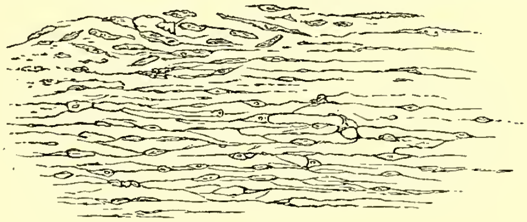

FIG. 5.

II.—CONTRIBUTION TO THE GENERAL HISTORY OF CONICAL CORNEA, DRAWN FROM MY OWN OBSERVATIONS.

1. I have observed a very few cases in which it occurred in more than one member of the same family. The usual age at which it commences is from 15 to 25, but it may begin earlier, and as late as 50.

2. It is very often, but not always, attended by signs of delicacy of constitution, such as an hereditary tendency to phthisis, over rapid growth, a weak digestion, feeble circulation.

3. It very commonly occurs in both eyes, sometimes simultaneously and equally, more often unequally, so that vision is worse in one eye. I have seen several cases in which it has affected only one eye, but in these, it has with very few exceptions remained slight. One man of 60 had an extreme degree of it in one eye, none in the other.

4. It may become stationary at any degree, from such a slight bulge as can be only detected by the ophthalmoscope, up to an extreme irregular bulge and opacity destroying the sight of all but the largest objects.

5. It never advances to bursting, either by extreme stretching, or by ulceration, or by sloughing.

6. It always proceeds gradually, but with variable speed; when come to a stand it sometimes, though rarely, may take a fresh start.

7. When the tendency exists, it seems to be aggravated by whatever strains the eye; consequently over use and everything inducive of congestion is to be avoided; local fulness is to be combated by the usual remedies, while the general strength is to be upheld by all suitable means.

8. In many cases, especially those of a slight and slow progress, there is no mark of weakness or excitement in the circulation of the eye; in others the ciliary vessels are overcharged, often, perhaps, from imprudent efforts to use the organ when sight is failing.

9. Soon after the immortal invention of HELMHOLTZ, I found the ophthalmoscope very useful in detecting slight degrees of conical cornea. For this purpose the concave mirror only is to be used without a convex lens. On turning the mirror so as to throw light at different angles, the side of the cone opposite to the light is darkened. Probably every one is now familiar with this test. Professor DONDERS told me last year that he had himself observed it. It is a very useful one in discriminating the cause of slight defects of vision, somewhat resembling myopia, and hitherto deemed anomalous. I have seen many such cases.*

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* [" My friend BOWMAN recently informs me that 'he has been sometimes led to the discovery of regular astigmatism of the cornea, and the direction of the chief meridians, by using the mirror of the ophthalmoscope much in the same way as for slight degrees of conical cornea. The observation is more easy if the optic disc is in the line of sight and the pupil large. The mirror is to be held at two feet

10. As to the physical state of the eye, I have observed that there is no undue tension of the globe appreciable by the touch; in some instances I have even thought the tension rather less than natural. In these examinations I have endeavoured to distinguish between the tension of the vitreous and aqueous regions of the eye, as I conceive it is desirable to do in reference to all the diseases in which the ocular tension comes under consideration.

11. The pupil is apt to be large, and sometimes the iris inclines to be tremulous.

III.—Rationale of the Disease.

It seems certain that the bulging of the cornea is due not to an increase of the normal intra-ocular pressure, but to a diminution of the resistance of the cornea itself. In the natural condition, the cornea is sufficiently strong to maintain its true curvature under the ordinary tension; and even when this tension is augmented, and continues so for a long period, the cornea does not bulge, unless it has previously undergone visible change of structure, and rarely even then. The ciliary or posterior regions of the sclerotica bulge rather than the cornea. I conclude this softening of the cornea to occur only in the bulging part, and not near the margin. At first the softening is not attended with such alteration of the anatomical elements as to produce opacity; but as the bulging increases this alteration does take place, either as a further stage of the same process of softening, or as a consequence of the stretching of the softened part.

It has often seemed to me remarkable that the bulging never goes on to bursting. The reason probably is, that as the cornea becomes thinner, the escape of the aqueous humor by exosmose is facilitated, and thus the internal pressure is reduced so as to be no longer in excess of the diminished resisting power of the cornea. A balance is re-established like that of health, only that there is a more than ordinary out-flow of the aqueous humor by transudation through the cornea. This accords with my previous observation, as to such eyes being rather unduly soft. I do not pretend to explain why the cornea should thus occasionally tend to become less resisting and tough in its central region. Is this the consequence of some undefined change in the chemical constitution of the lamellated tissue? I can hardly venture to assign it with any plausibility to a primary alteration in either the anterior or posterior elastic lamina. Certainly the membrane of Descemet is not strong enough to bear any important part in the production of this disease; and as for the anterior membrane, I have many times extensively removed it with even some of the

distance, and its inclination rapidly varied, so as to throw the light on the eye at small angles to the perpendicular, and from opposite sides in succession, in successive meridians. The area of the pupil then exhibits a somewhat linear shadow in some meridians rather than in others.'" Donders, 'Anomalies of Accommodation and Refraction of the Eye,' 1864.]

lamellated tissue without observing the slightest after-tendency to conical bulging of the cornea.

IV.—Treatment.

No reliable testimony exists as to the success of any measures hitherto adopted for the restoration of the cornea to its natural curvature, though possibly, it would be wrong to say that it is not an object to be aimed at in slight and early stages.

Indications for Treatment by Arrest.

These are two—to check the softening process, and to diminish the intra-ocular pressure. As to the former, in the imperfect state of our knowledge, we can only pursue measures of a tonic kind, which are, indeed, very commonly indicated by the general symptoms. When there are signs of congestion it is most important to meet them by the cold douche, by very moderate and cautious local abstraction of blood in certain cases, by abstinence from all that kind of use and exposure of the eyes which excites and reddens them, and from shedding tears.

My friend, Professor von Graefe, has, within the last three or four years, discovered the important fact that the excision of a portion of the iris diminishes the intra-ocular pressure, a fact of pregnant interest in many diseases of the eye, and which he has applied with consummate skill to the treatment of glaucoma, of certain staphylomata, and last autumn to that of conical cornea. While agreeing that when this latter disease has attained a certain degree and a certain age, all medical treatment is useless, he gives a case in which he practised iridectomy, with the double object of favourably modifying the position of the pupil and of lessening intra-ocular pressure, and he thinks with good results in both respects. ('Archiv. für Ophthalm.,' Vol. IV, Part II, p. 271.) The history of operations undertaken in cases of conical cornea is interesting; but up to this time none has come into general use. Mr. Wardrop repeatedly tapped the aqueous chamber, Sir Wm. Adams removed the lens by solution. Mr. Tyrrell drew the pupils outwards and downwards with the blunt hook, excising the prolapsed portion of the iris. If the iris then remained in the puncture, the pupil must have been balloon-shaped and probably useful (see further on); but if it receded—an equal chance—the pupil would be a large irregular one, partly opposite the margin, and partly behind the central bulge of the cornea, and probably of little value. This operation has been the only one yet attended with any good result. Mr. Tyrrell himself tried it in several instances with advantage, in two with great improvement of sight. His great authority led surgeons to repeat his suggestion, but with variable and conflicting results, and I believe the proceeding has never come into common use with any surgeon. One eye was lost by destructive inflammation. In two the confusion of vision was aggravated. Mr. Walton has several times performed it without the slightest benefit. Mr. Wilde modified it by refraining from the excision of the prolapsed iris, and with marked advantage. Mr. Cooper and others had also variable, and on the whole unsatisfactory, results. (*See* a good *résumé* in the American edition of 'Lawrence on the Eye,' by Dr. Hays, p. 393.) At present I believe it may be safely said that operative proceedings in conical cornea have been generally abandoned as hazardous and uncertain. Some patients have been unwilling to submit to an operation when the surgeon could not promise a definite advantage, and the surgeon himself has often preferred the less formidable contrivances devised by the optician, which have been frequently found of great use. In fact, at Moorfields, I hardly remember that any operation for the relief of conical cornea had been practised of late years until it occurred to me in 1857 to attempt to modify the pupil by a new method.*

It has long been known that an eye thus affected often sees much better when either a small hole or narrow slit in an opaque diaphragm is placed immediately before the eye. This is owing to the interception of all but a narrow pencil or plane of rays, which passing either laterally or centrally, form a more or less true image unconfused by admixture with others less accurately converged, entering through neighbouring and more distorted portions of the corneal surface.

Such a contrivance has to be applied with a certain amount of skill, and to be moved as the eye itself moves, and it is seldom useful except for very near vision, because the area of the field is so contracted. To be useful, the aperture must be brought very near the cornea, and on the whole, though often far better than nothing, it is ill-adapted to poor and uninstructed persons. The idea on which I proceeded was so to operate on the iris as to give the pupil a slit-like shape, and to fasten it to the cornea in such a position as to conduce to the formation of the most correct image compatible with the altered curve of the cornea in each particular case.

It seemed likely that if the slit-like aperture could be placed within the eye, immediately behind the cornea, it would be more useful than the artificial perforated diaphragm placed outside. Without confining myself, however, to this idea, I have been endeavouring for the last two years to discover experimentally what modification of the pupil artificially produced was most effectual in improving vision. In no case have I had reason to regret having operated; no case has been made worse; all, with one exception, have been improved, and none has caused anxiety by inflammatory threatenings consequent on the operation.

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* From 1824 to 1856 the records of Moorfields contain only two cases of operation for conical cornea, one of which was in 1825 and one in 1841. In November, 1857, and January, 1858, Mr. Critchett extracted the lens in the left and right eye of a patient but without a definite improvement of vision, and iriddesis was subsequently performed in July and October.

The first case* I shall relate is that of Sarah Collins, æt. 26, who for eight years had been delicate, and for six years had suffered from conical corneæ, both being equally prominent and both transparent. With this exception, the eyes were quite natural; she could with an effort read the smallest type for a few moments if held very close, but had been compelled to abandon her employment on account of the impossibility of seeing the objects around her.

On April 30th, 1858, I operated on each eye in a different manner, but with the same object, viz., that of drawing the pupil outwards to a fixed point at the margin of the cornea, as the first step towards forming it into an horizontal slit. On the left eye I excised a minute marginal portion of the cornea by the help of a broad needle (*corneëctomy*—the operation of Guepin modified); a small portion of iris was immediately protruded, and the pupil became transversely balloon-shaped, the margin of the pupil not being involved in the hernia. On the right eye I performed the operation of *tying the iris*, then just devised by my friend, Mr. Critchett, to meet the want we had long felt of a sure method of fixing the iris to the point of puncture in cases of artificial pupil. (*See* 'Ophthalmic Hospital Reports,' Vol. I, p. 225, October, 1858.)† In both eyes the canula-forceps were used to seize and draw out the iris to the degree desired, the point seized being about one-third from the pupillary margin, so as to leave the margin still free within the aqueous chamber. The object in each eye was attained, but with so much less irritation from the iriddesis that in all subsequent operations I had recourse to this method, which I regard as one of the most useful improvements made of late years in the operative surgery of the eye, giving, as it does, precision and certainty with perfect security under all ordinary circumstances, to the operation for artificial pupil, in the very numerous cases to which it is applicable. The sight being now much improved, but most so in the right, I operated inwards, or at an exactly opposite point, in both eyes on the 21st May, the immediate result being a transversely oval pupil in each. In the right eye the margin of the pupil was entirely free; in the left the margin was adherent to the site of the corneal wound. Hardly any irritation ensued. At the end of two days the ligatures dropped off; the pupils acted promptly, the left being more slit-like than the right. In both eyes vision was immediately much improved, and a gradual further amendment has since gone on, apparently owing to a certain receding of the corneal bulge.

The girl has become able to resume her occupation of a housemaid, and is able even without concave glasses to see the objects in a room with tolerable accuracy; with a glass she can see distant objects still better.

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* A brief note of this case is given in 'The Ophthalmic Hospital Reports' for July, 1858 (Vol. I, p. 211).

† ["I may just mention here that this method of operating (iriddesis) has been adopted by my friend Mr. Bowman in some cases of conical cornea, for the purpose of *converting the pupil into a narrow slit.* It perfectly succeeded in effecting the desired object, and I think it may be safely affirmed that this could not have been efficiently performed in any other way."—G. Critchett, *loc..cit.*]

I have operated since on six other patients, on five of them in both eyes. I have operated so as to make the pupil vertical rather than horizontal in all these cases, and in several have experimentally modified the operation in regard to the point of the iris seized by the canula-forceps, and so as to test the value of that instrument, compared with the short blunt hook for seizing the pupillary edge. This last I now prefer, as being simpler and less apt to injure the iris, while it affords greater precision in fixing the pupillary edge to the wound. I find, too, no disadvantage in engaging the pupillary edge in the wound, the pupil acting as well afterwards as when the natural pupil is still entirely within the chamber. I have tried to perform iriddesis in the opposite directions on the same eye on the same occasion, but found that the point first tied was apt to be drawn unduly into the chamber while the opposite point was being drawn out, so that I think it better to do the second iriddesis on the same eye a week after the first.

In one of the earlier operations with the canula-forceps there was a little bleeding from the stretched iris into the chamber sufficient to disguise the later steps of the operation, but with the short hook this has never occurred. These operations from their extreme delicacy should be done under chloroform, the influence of which should be sufficiently complete to place the organ in complete repose; one minute is sufficient for each eye when dexterously managed. If sickness ensue it does no harm to the eye. No iritis suffusing the pupil has followed in any case, but, of course, the usual care has been taken to keep the eye cool and quiet for a few days after the operation. If the thread remains on after three or four days, it may be pulled away with forceps. It is of great importance to the perfection of the operation that the puncturing instrument and the blunt hook should be of equal size, so that a sufficient opening, but not more than sufficient, is made for the free passage of the hook; otherwise the hook does not enter easily, or on the other hand, the knot is prone to slip back into the puncture, or even into the aqueous chamber. The recurved part of the hook should be long enough to hold the pupillary margin, but so short as to admit of the ligature being tightened the moment this margin is outside the puncture. I always leave one end of the silk nearly an eighth of an inch long, so that it may be readily laid hold of afterwards, should it chance to have fallen at all inwards or be concealed by a coating of lymph. These may seem trifling points, but in my opinion have their importance, and are not unworthy the attention of anyone performing this operation for the first time: they pertain to the excessive delicacy of the structures and of the whole proceeding.

It has been a matter of great interest with me to ascertain, as far as the limited number of cases presenting themselves enabled me, how far the second iriddesis was useful—in other words, whether an elliptical or slit-like pupil gave better sight than one of a balloon shape; and again whether the vertical direction was better than the horizontal, or the reverse; also whether other modifications in the direction of the altered pupil were desirable.

Of course, this is a subject which must be worked out in detail by surgeons, and the following remarks are but hints for future experimental enquiries.

The slit-like figure of the pupil suggested itself to me as the most feasible method of much limiting the size of the pupil while changing its situation. If the thing be well considered, it will be found difficult to conceive any plan of rendering the pupil *very small* by operation; it is much more easy to *enlarge* it. While the pupillary margin is free any displacement of the iris is most likely to enlarge the pupil, for I despaired of being able to seize the iris at one side of the pupil and draw and fix it over towards the other side. Any excision of the iris must, of course, enlarge the pupil, and so must any marginal iriddesis; but by a double iriddesis in opposite directions the central region becomes slit-like. By making this slit *horizontal* the light is admitted from each side, as well as through the centre, and the range of the field would be probably expanded, while the precision of the image would be impaired by the inequality of refraction through the central and marginal regions respectively. The appearance of the horizontal pupil was besides not agreeable. The *vertical* position of the slit offered the prospect of its virtual reduction in size, by the overlapping of its angles by the lids in ordinary vision; and I hoped that the patient would learn to use the lids for this purpose, so as to clarify the image. I cannot say that this expectation has been borne out in any marked degree, but nevertheless the vertical slit is much more sightly than the horizontal, and certainly equally good for vision, so that at present I prefer it.

The improvement of vision from a first iriddesis downwards has been in almost every case decided, the patients being delighted with the result. In some the second iriddesis upwards has not seemed further to increase the precision of view, in others it has certainly done so, and in the present state of the inquiry I am disposed to continue to practise it in cases of considerable conicity. The improvement, however, consequent on the second operation, is never so marked as that which follows the first, and it can only operate by narrowing that part of the pupil which lies behind the bulge. Its more or less influence in different cases may perhaps depend on varieties in the curvature of the apex of the cone.

The influence of these operations in lessening the corneal bulge has been very remarkable. It is not easy to give in any case the exact amount of this result, but that the bulge diminishes speedily, and continues to do so for a considerable time subsequent to the operation, admits of no doubt, and I attribute it to the moderating of the ocular tension. Further experience will show whether I am right, but at present I am for operating quite early in slight cases in a downward direction only, if only to arrest the progress of the conicity; and certainly to obtain this result in almost any degree, will make it worth while to perform so safe an operation in a disease otherwise so intractable, and in its advance, so destructive of all useful sight.

It is interesting to observe the movements of the pupils after these operations. The following diagrams exhibit the states of dilatation and contraction in the case of horizontal slit, of vertical slit, and of the balloon-shaped pupil from iriddesis downwards ; *a*, dilatation ; *b*, contraction.

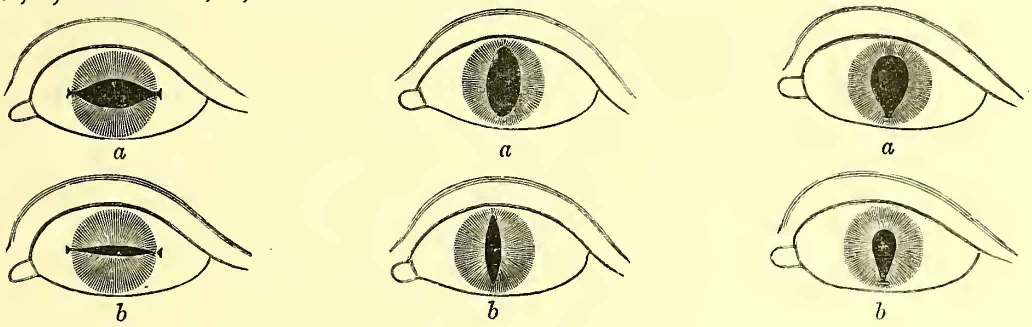

FIG. 6.

The following represents the stages of treatment in one of my cases recently in the hospital :—

Lucy Milton, æt. 18, a fair, healthy girl, has suffered from conical corneæ for two years, and the defect increases. There is no opacity. She has been quite unable to keep in service. The left eye, having the worst sight, was the first operated upon by iriddesis downwards. This was on the 14th of October in the present year. The improvement was so great that the right had now become the worse eye, and accordingly it was in its turn subjected to the same process on the 26th. Before these operations the left could not count fingers at a greater distance than eight inches, and the right at a greater distance than four feet. After then, both eyes could do the same at twelve feet. The second iriddesis was performed on the right eye on the 11th of November, and on the left on the 22nd. The girl herself was in each case positive in her assertion that vision was still further improved, though such tests as she could be put to, by the optometer or other wire, did not seem to bear this out in the case of the second iriddesis.

The amount of conicity before the operations, and a week after the last of them, is exhibited by the accompanying figure, where the cornea is shown in ideal section. The improvement has been little exaggerated by the draughtsman.

After the second iriddesis the left eye accommodated for the optometer wires from 1 inch to 1 foot 9 inches ; the right eye from 1 inch to 2 feet 1½ inches.

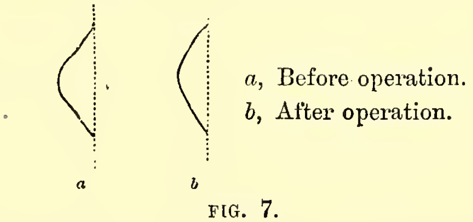

FIG. 7.

In addition to the six patients operated on by myself, four others have been operated on by my colleagues Messrs. Critchett and Poland, with satisfactory results as to the influence of this method. Two of these, however, were complicated with extraction of the lens. My friend Mr. Lawson has also had a satisfactory case.

XVI.

IRIDECTOMY IN GLAUCOMA.

By William Bowman, *F.R.S., in* '*The Medical Times and Gazette,*' *August* 25*th*, 1860, *p.* 176.

There has recently appeared in the 'Dublin Quarterly Journal of Medical Science,' a review, intending to discredit the treatment of glaucoma by iridectomy, as advocated by von Graefe; and as this treatment seems to me of the utmost value in a class of cases hitherto little or not at all under control, but leading sooner or later to hopeless blindness, as confessed by the reviewer himself, I think myself bound to offer some remarks upon it, for I believe I was the first (in May, 1857) to apply this treatment in England, and having soon convinced myself of its importance, I have since constantly advocated its general adoption, in the cases to which it seems reasonably applicable.

It is impossible within the limits of such a paper as this to enter at large on the numerous questions opened by the brilliant researches of the Berlin Professor, as to the essential nature of the glaucomatous process, the modifications it assumes in persons of different ages and constitutions, its acute and chronic forms, and its relations with disease of other kinds occurring in the eye or in the system at the same time. These will furnish abundant material for the labours of the coming time; at present, we are concerned with the practical question, How are we to treat the patients of to-day? The reviewer says they are to be treated as they have hitherto been treated, while he allows their incurability by such methods. "Chronic and acute glaucoma," he says, "are nearly always fatal to vision." He rests so firmly on his prejudices as not to have thought it worth while even to try the new practice, styled by him "the glaucoma dodge," which he informs us, "to the honour of the Dublin School, was openly and fearlessly denounced by the Dublin Medical Press on February 10th, 1858," that is, before it could possibly have been submitted to any practical test. What is worse in a man of science and intelligence, he now disparages the treatment on *à priori* grounds, after the world has had three years of the positive testimony of facts in its favour, and he claims credit for dulness in appreciating what is already acknowledged to be most excellent by the ablest ophthalmologists of Europe. But I most of all lament that he should have mentioned, in terms of personal disrespect, the distinguished author of this method, one who has borne so eminent a part in transforming the ophthalmic knowledge of 1850, into the far more advanced, and more scientifically based ophthalmology of the present day. The Profession in Ireland, and even in England, is interested in discountenancing this tone and attitude in one professing to speak in its name; and were it not that the review is understood to have proceeded from a high and most respectable authority, and has been widely distributed in a separate form, it might have been better to let it pass by in silence.

In reverting to what ten years have done for ophthalmic science and practice, it is impossible to disconnect the new proposal for treating glaucoma from the general advances, dating from the immortal invention of the ophthalmoscope by HELMHOLTZ, and the recent enlightenment regarding the anatomy and physiology of the eye as a part of modern science. When my friends, Professor DONDERS, of Utrecht, and VON GRAEFE, of Berlin, visited our metropolis in 1851, at the time of the Great Exhibition, as young men yet hardly known, it was evident that they were about to take a large share in the development of ophthalmic science. Both highly gifted, and profoundly versed in the more recent physiology, they were devoting themselves to a subject then invested with new and extraordinary interest (for those who could read its importance) by the instrument of Helmholtz. DONDERS has since founded a School and Hospital of Ophthalmology in Holland, and has enriched science by many physiological, pathological, and practical writings of great originality and value, and by none more than by his great work (just published) on 'Ametropia,' or the nature and treatment of the disorders of refraction and accommodation, of which I trust the New Sydenham Society may be induced to give an early account in one of its admirable volumes. He fully accepts and practises the new treatment for glaucoma. The career of VON GRAEFE has been not less remarkable, and, as might have been expected from the vivacity of his genius, more dazzling than that of his friend. He, also, at Berlin, has founded a new School of Ophthalmology, and become the centre of progress in Germany. He has penetrated to its depths every subject he has touched upon. His study of the complex problem of the action of the ocular muscles, and his researches on the cognate topics of diplopia and strabismus, exhibit a masterly intellect, acute faculty of observation, and great fertility of resource—qualities equally displayed in his papers on 'Iritis,' 'Choroido-Iritis,' and 'Glaucoma.' His successive memoirs on the last-named subject in particular, are marked by qualities of the first order, the keenest perceptive power, a readiness in detecting hidden relations where least expected, caution in arriving at results, but the utmost boldness in framing measures of treatment answerable to his conclusions when drawn. The intense activity of his mind, and his enthusiastic earnestness of purpose, can hardly be conceived by those who have not witnessed them, while his liberality towards all his colleagues, and the transparent candour of his disposition, make him universally beloved.

The term "glaucoma," as now understood, embraces much more than the etymology would import, or than the reviewer, imbued with the ideas of ten years ago, seems to suppose. To trace the conditions which often lead to that state of utter blindness, with dilated pupils of sea-green hue, which alone formerly received that name, and to arrest them while still possible, was the aim of von Graefe, and seldom have researches been conducted in a more philosophic spirit, or been crowned with a happier result, than these.

The treatment by iridectomy has been no haphazard guess, but a rational conclusion gradually worked out. The dominant idea guiding the mind to the appropriate remedy has been that of the existence of augmented intra-ocular pressure, as the main characteristic of the glaucomatous process. In fact, whatever the essential nature of that process, its concomitant seems to be a marked tendency to hardness or tension of the eyeball, and thereupon arise the most serious secondary effects—paralysis of the retina, oftentimes interrupted circulation, congestions, inflammatory attacks, with their various consequences—ending sooner or later, and with more or less of intermissions, in total loss of sight, and a spoiling of all the tissues of the eyeball. The general states met with in practice and falling under the general heads of amaurosis with excavation of the optic nerve, chronic, sub-acute, and acute glaucoma, all seem to be allied to one another, and may be termed "glaucomatous diseases." Some are very slow in their progress, and the loss of power in the retina very gradual; there is no inflammation or even congestion; in others there is congestion, slight or considerable, intermittent or continuous. In others, again, acute and intense inflammation arises. A glaucomatous state may also come on in the course of other diseases, choroidal, retinal, or cataractous. To relieve intra-ocular pressure seems to be the prime indication in all, and it is rational to suppose that it will be the more effectual, the less deterioration of structure the retina has previously suffered. To relieve this pressure is to disarm the glaucomatous state of its chief peril, and apparently to restore the eye to the influence of the reparative powers belonging to it as a living organ. The tension once relieved, and so long as it remains so, the circulation tends to its natural equilibrium, and the retina, which has been compressed, recovers itself more or less, or ceases to degenerate, in a degree usually corresponding inversely with the intensity and duration of the preceding pressure.

It is certain that this critic would never have attacked the new practice had he really read von Graefe's memoirs, or believed the cures, reported by others, to be genuine. He says, "Graefe's doctrines, as published by the Sydenham Society, are plausible, but in a practical science of this nature we require something more than doctrines; cases must be given, and Graefe was wiser than his country-man* of the London Ophthalmic Hospital, and kept his cat in his bag." Will it be believed that the reviewer can have read the memoirs of von Graefe, which he criticises, which are enriched with numerous cases, fully detailed and epitomised, and constantly referred to, illustrating all the main doctrines advanced? As for the experience acquired in England, I shall at present speak only for myself, and I can assure the reviewer, in the most decided terms, of the reality of the influence of this operation in relieving, even permanently, the unnatural tension of glaucomatous eyes, and of its effect in arresting the glaucomatous process, and often in restoring sight in a marvellous manner. My own cases in the hospital and in private have been numerous, and bear out the above general statement. This it is that makes me so anxious that the Profession should be rightly informed as to the signs of glaucoma in its relievable stages, and should be ready to sanction the timely application of the only known real remedy. I can hardly conceive a greater comfort in practice than to be able, by this operation, to rescue sight thus imperilled, and to escape the disheartening task of treating a disease, evidently tending to blindness, by the old, ineffective remedies. The reviewer may class the eminent author of so great a boon with "Hahnemann, Preissnitz, and De Leeuw," but he may depend upon it he will be powerless to "arrest the spread of the 'glaucoma epidemic' in England." I could, indeed, heartily wish that, when he has further examined into the evidence, and dispassionately perused what he criticises, he will make a trial of the operation for himself, in which case I doubt not he will be satisfied with his results.

In speaking in these terms of iridectomy in glaucoma, I must carefully guard myself from being supposed to uphold it as a sovereign remedy equally valuable in all forms and stages of the disease, and under all its various complications. At present the operation is being extensively tried in cases where augmented intra-ocular pressure evidently exists, and the proved tendency of the operation to relieve this injurious tension, the certain cause of secondary mischief, makes it our duty to employ it, when the patient is otherwise apparently drifting into inevitable blindness. It may be our misfortune, and that of our patients, that our experience is as yet less complete than a few more years will make it; but meanwhile we can only act on the light we possess, and store up the results for the future benefit of others.

While the modern doctrine and treatment of glaucomatous affections is so new, it is to be expected that errors in the diagnosis may occur even among well-instructed practitioners; and the operation is doubtless in some danger of being brought into discredit by being undertaken in cases to which it is not rationally applicable, or by being defectively executed. I do not see how this can be avoided; it is the necessary fate of all novel proposals, and this one must face the ordeal. It is the part of intelligent men to make allowance for these incidents of human progress, rather than to allow them to prejudice the march of truth.

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* Referring to the report of cases of operations for glaucoma at the Moorfields Hospital, given in 'The Ophthalmic Hospital Reports' by my friend Dr. Bader, who is quite able to defend himself.

In the present state of our knowledge it may be right to try the operation experimentally in some cases to which more extended experience may show that it is not usually applicable. Experience hitherto shows that it is most valuable when performed *early* in *acute cases*, in which turbid effusions exist, the absorption of which goes on rapidly when the tension is relieved. Temporising measures in such cases, such as bleeding, mercury, colchicum, and even simple puncture of the eye, whether of the aqueous or vitreous regions, are not to be relied upon, and occasion dangerous delay. It is also most useful if performed in the sub-acute form, when the visual field is not as yet seriously contracted, but where the symptoms are steadily advancing. If postponed here till the sight becomes greatly impaired by gradual alteration of the tissues of the retina, and of the optic nerve-entrance, the ultimate advantage is smaller, though usually lasting. In many instances we are called on to treat patients already almost blind from the progress of the disease under one or other of its various forms. Here it has often been the means of sparing them a little sight, sometimes permanently, at others not. I have also tried the operation in some examples of blind and tense glaucomatous globes, the seat of excessive or wearisome pain, and on several occasions have been well satisfied with the result. How intractable such cases are apt to be under the usual palliatives is well known.

As for the operation itself, a large experience has convinced me that, though usually a simple proceeding, not liable to accidents, it is occasionally one of the most delicate and critical in its nicety of all the operations on the eye. The anterior chamber has to be entered at its extreme rim, where the sclerotica overlaps the cornea, close in front of the iris, which often bulges much, and which must on no account be pricked, lest the vitreous humor or the lens, immediately behind, should be wounded; in either case a most serious complication. The bulging of the lens, in many cases, and the dilation of the pupil, add to the risk of injury to the lens. A little blood, too, escaping into the anterior chamber, either before or after the excision of the iris, may obscure the parts from view, and add to the chance of involving the vitreous humor or lens. It is obvious that these difficulties and contingencies ought to be acknowledged and recognised in order that they may be guarded against. In very few instances indeed can they lead to accidents in skilful hands. When blood occupies the anterior chamber in the course of the operation, it is wise to remove it, either by a gentle stroking movement of the *curette* over the cornea towards the incision, or, if that do not suffice, by carefully introducing the end of the *curette* within the incision itself. On two occasions only have I known the lens to become opaque after the operation, where the capsule was not directly injured (as it ought never to be) by the instrument. One of these was in my own practice, another in that of a highly esteemed colleague.

I am unwilling to extend this already long comment on the review by any enquiry as to the *rationale* of the operation; but there is much in favour of von Graefe's original suggestion, that the diminution of intra-ocular pressure may be largely due to the lessening of the iris as the surface secreting the aqueous humor. My own opinion, however, was, and is, that the more direct communication opened between the vitreous and aqueous regions of the eye facilitates the play of currents between them, and thus allows an excess of fluid behind to come forward to the corneal surface, through which exosmosis is much easier than through the posterior coats, the sclerotic, choroid, and retina. This would go far to explain the apparently contradictory influence of the operation in raising the tension to the natural degree when previously diminished; for this also it is capable of doing in some cases, as shown long ago by von Graefe himself. That the size of the piece excised in glaucoma has a direct relation to the effect produced is true according to his latest observations, confirmed I believe by those of Donders, and of Arlt, the distinguished and most able Professor of Vienna. I can also add my own corroborative testimony. Von Graefe is thus led (in his latest memoir, just published) to insist once more, as he had done in his first paper, on the necessity of removing a considerable portion of the iris (not, however, so much as a third, or even a fourth, of its circuit), where it is wished to reduce permanently the intra-ocular pressure. A small iridectomy is insufficient, much less any mere puncture, such as some are still inclined to rely upon.

In conclusion, I may remind the reviewer, that after the reading of Mr. Hulke's excellent paper "On the Pathology of Glaucoma," at the Medical and Chirurgical Society, on January 12th, 1858, both Mr. Critchett and myself endeavoured, from our own experience, to enforce the importance of von Graefe's new proposal (*see* 'The Medical Times and Gazette,' January 23rd), and that in our weekly operations at Moorfields, all comers have had the opportunity ever since of watching the progress of our numerous cases, as well as of those of our colleagues. Mr. Hulke advocated and explained this treatment in detail in an able paper "On the Surgical Treatment of Glaucoma," in the 'Medical Times and Gazette,' March 27th, 1858 (Vol. XXXVII, p. 316), referring to the favourable experience of Moorfields and to my own private practice, in which at that time I had the advantage of his assistance. He has recently reverted to the subject in a second paper at the Medical and Chirurgical Society. To both these latter communications I venture to draw the attention of practitioners. The reviewer is in error when he states that there has been any holding back of opinions or of facts on the part of those who have introduced the operation into England

NOTE.

[The following letter from the veteran surgeon, Mr. LAWRENCE, F.R.S., (afterwards Sir WILLIAM LAWRENCE), author of the work on 'Diseases of the Eye,' has an interest in connexion with the foregoing, and is therefore appended:—" To the Editor of 'The Medical Times and Gazette.' Sir,—I am indebted to the polite kindness of Mr. BOWMAN for the opportunity of examining two of his private patients, in whom iridectomy has been performed with complete success. These cases illustrate so clearly the kind of disease most suitable for the operation, and the period of the affection at which it can be performed with the best prospect of success, that your readers will be gratified by finding that Mr. BOWMAN, at my request, has consented to their publication.

" CASE 1.—In Mr. S., a healthy person, of spare habit, past sixty, the sight of the right eye was entirely lost eight years ago from glaucomatous inflammation. In December, 1858, he suffered an acute attack in the left eye with agonizing pain, sudden and almost total loss of sight. He was unable to see his own fingers; he told me, indeed, that, from the intolerable pain and the imperfection of the sense, he could not distinguish light from darkness. Mr. BOWMAN excised a portion of iris on the third day of the attack. He can now read a very small type (No. 2 of Jäger's—Pearl) without convex glasses.

" CASE 2.—Mr. J., a gentleman of good constitution and health, between fifty and sixty, accustomed through life to much use of the eyes in reading and writing, has had acute glaucoma first of the right, and subsequently of the left eye. On the 28th of last July he was unable to count his own fingers, or see at all in front or to the left side with the right eye from acute glaucoma, which had then existed one week. Iridectomy was at once performed, and all other treatment abandoned. He steadily improved, and can now read with his old convex glasses a small type (No. 3 of Jäger's test). The visual field has extended over the central region, but he has not regained any sight on the extreme left of that eye, as Mr. BOWMAN told him would be the case, the operation having been delayed till too much damage had been done. The sight, however, of this eye is still improving. On the 11th he came to London with the left eye more acutely inflamed from glaucoma than the other had been, but it had only been so for forty-eight hours. He could barely see that there was an object before him, but could not tell what it was. Iridectomy was immediately performed. He can now (Tuesday) see No. 9 of Jäger, on Saturday only No. 14, and he sees over the whole field. Mr. BOWMAN has no doubt that this eye will recover perfect sight.

" The inferences from these very interesting cases are so clear that remarks would be superfluous.

"I am, &c.,
"WILLIAM LAWRENCE.

" *Whitehall Place, October 24th.*"

See 'Medical Times and Gazette,' October 27th and November 10th, 1860.—J. W. H.]

XVII.

ON GLAUCOMATOUS AFFECTIONS, AND THEIR TREATMENT BY IRIDECTOMY.

Read before the British Medical Association, at its Thirtieth Annual Meeting, London, August, 1862.

By William Bowman, *F.R.S.*

Extract from ' The British Medical Journal,' October 11*th*, 1862, *pp.* 377–382.

We have fallen on a time that will be for ever memorable in the history of ophthalmic science—the epoch of the invention of the ophthalmoscope.

What would be thought by physicians if they were presented with an instrument enabling them to *see* the membranes, the cavities, the course of the fibres, the configuration of the ganglionic masses of the *brain*, with the vessels pulsating, the veins varying in emptiness or repletion, and every product and physical condition of disease exposed to view? Or, if the great organs of the chest or belly, with all their complicated connexions and movements in a healthy or unhealthy state were disclosed? They would be transported with delight at the facilities given for the exact detection of disease: and doubtless a harvest of great results would instantly be reaped in the field of practical medicine.

What I have imagined for the great cavities of the body came to pass for the delicate structures of the eye about eleven years ago. We may be all *clairvoyants* now for this hollow organ, into which we can penetrate by the aid of the reflector, and discern (in all cases where the media remain transparent) the physical conditions of the internal coats, with the exquisite course and aspect of the vessels, and the faintest morbid alterations of structure, as clearly and brilliantly as if they were opened up by the anatomist, or placed under a lens on the table before us; and where the media are themselves faulty, the faults can be detected in their earliest and slightest forms by the same means. So long as there are human eyes to suffer damage from disease, or cultivators of the divine art of healing, so long will the ophthalmoscope be in universal use, and the name of Helmholtz be held in honour among mankind. No less than a total revolution in ophthalmic practice has been already effected by this instrument: and constant further advances may be confidently anticipated in our knowledge, not only of the diseases of the eye itself, but collaterally of various cognate affections of other organs, especially of the brain.

A glaring example of its value is to be found in its bearing on the subject of glaucomatous diseases, the name of which, indeed, is old, but the knowledge and the practice are all new. These diseases now begin to admit of accurate definition, of exact discrimination, and, in many cases, of the most admirable cures; diseases which, six years ago, marched on unchecked to more or less rapid destruction of sight. And I do not scruple to say that, were the scientific knowledge of them, now possessed by a few, diffused universally among all the members of our profession, failure of sight from this cause in Great Britain would be to a considerable degree prevented, and total blindness would be rare indeed.

Since the winter of 1856-7, the splendid researches of von Graefe on the nature and treatment of glaucoma have prominently attracted attention. On the Continent his proposal to arrest the disease by the excision of a portion of the circle of the iris has been adopted and practised by the ablest men, including especially Professors Donders, of Utrecht, Arlt, of Vienna, and Desmarres, of Paris. In May, 1857, I first performed it in England. At the Ophthalmological Congress at Brussels, in September following, von Graefe gave an account of his researches, and distributed amongst his friends an essay on the subject, then just presented to the French Institute. In the ensuing autumn, *iridectomy, as a remedy for glaucoma*, was, in my opinion, and in that of my friend and colleague, Mr. Critchett, established by the facts we had ourselves observed, as a proceeding competent to cope with the disease, by reducing that tension of the eyeball, and compression of the retina and its vessels, which is the cause of the loss of sight: and we attended a meeting of the Medical and Chirurgical Society (when a paper on "The Morbid Anatomy and Pathology of Glaucoma" was read by my friend Mr. Hulke), in order that we might call attention to the proposal of von Graefe, and offer our voice in its favour. (*See* 'Medical Times and Gazette,' Jan. 23, 1858.)

It was our earnest wish that the value of von Graefe's discovery should be early and extensively acknowledged by medical men, so that those suffering from so serious a malady might no longer be drifting, as before, into hopeless blindness. Since then we have with no faltering voice continued to advocate the practice, and have performed the operation on all suitable occasions, both in private and in public. At Moorfields, iridectomy has been exhibited and tested on a very large scale, scarcely a week having passed since 1858 without one or more instances of it; and a host of competent observers, both students and practitioners, have witnessed the method of performing it, and its results, in the hands of several of my colleagues and myself. A paper by Mr. Hulke ('Medical Times and Gazette,' March 27, 1858), on "The Surgical Treatment of Glaucoma," contains an excellent statement of the questions involved, including my own views at that period; and the new Sydenham Society, in one of their volumes for 1859, gave the detailed memoirs of von Graefe, translated from the 'Archives of Ophthalmology,' by Mr. Thomas Windsor, of Manchester. A letter of my own, in reply to an attack in an Irish journal on this method and its author, also appeared in August, 1860 ('Medical Times and Gazette,' August 25, 1860); and I there reiterated that we possessed in iridectomy an effectual means for mitigating the tension of the globe, and of relieving the glaucomatous condition.

The progress of truth, however, is proverbially slow, and accordingly there remain several ophthalmic surgeons, men whose ability and candour I am far from questioning, who, to judge from their latest published writings, and from cases I constantly meet with in private, in which they have been consulted, either have not yet made themselves familiar with the nice discrimination of the glaucomatous state, or who reject this inestimable means of controlling it. The consequences to patients are, of course, to be deplored. For it is natural, under these circumstances, that that large number of practitioners who only meet with these diseases among others in the course of ordinary practice, and who yet, as a body, are in the habit of seeing a very great proportion of all the cases of it in their earlier stages, should be perplexed, should discredit the reality of the benefit, and should content themselves with the old and common treatment, under which it is certain that valuable time must be lost. According to the activity of the disease, are hours, or days, or weeks of critical moment; and it is mournful to have still to pronounce, in too many instances, the fatal words, "Too late; at an earlier period sight could have been rescued."

Whatever the essential nature of the glaucomatous state, we as practitioners are chiefly concerned with the *augmented tension of the eyeball* which attends it. This we have to distinguish at the earliest stage, and towards the mitigation of this our treatment is to be directed. As a practitioner, having to relieve disease, I call *all undue tension* of the eye *glaucomatous tension.* The object of treatment is to reduce this within natural limits; for, if it continue, the result is inevitable, however delayed.

A person unused to close and accurate examination of the physical condition of the eyeball, even though he be seeing eye diseases frequently, may readily fall into error on this important matter of *the state of the globe as regards tension.* He may suppose that the increased tension may depend simply on the degree of fulness of vessels, or on the amount of effused fluids within the eye. No mistake can be greater. It cannot be too strongly impressed on all who may have to discriminate between glaucomatous and other diseases, that the depth of redness of the eye, or the presence of more or less of effused blood, or serum, or lymph, or pus within it, has no connexion whatever with the question of tension, since all or any of these may be present in a high degree without any glaucomatous disease, any increase of tension, and therefore without the indication such tension gives for its relief by iridectomy.

In various congestive or inflammatory states, whether of cornea, sclerotica, choroid, iris, or retina, or of some or all of these, the disease may be of more or less intensity, may run its course more or less rapidly, and may do permanent damage to the structures involved, without our detecting any augmented tension of the coats at any period. Intra-ocular hæmorrhages, as a rule, even when considerable, are not attended by a higher tension: often, indeed, by a diminished size of the globe-contents, and an unnatural softness of the eye. Subretinal effusions of blood or serum are, in the great majority of cases, unmarked by any increase of tension.

On the other hand, exalted (or glaucomatous) tension may occur, intermittently or persistently, in eyes which afford no indication whatever of inflammation, where there has never been any pain or vascular excitement, and where there is still an absence of inflammatory effusions. Such augmented tension, though slight in degree, may affect by long continuance and without any intercurrent inflammatory complication, what a pressure more intense will effect in a much shorter time, especially if, as then usually occurs, it becomes complicated with sub-acute or acute inflammatory action.

I must add, however, to avoid the risk of misconception, that various affections of the eyes, not glaucomatous in their origin, may present, in their course, glaucomatous complications, *i.e.*, become combined with an augmented tension of the eye, and with the secondary results of pressure; and hence, that it is of the highest importance in practice, to distinguish accurately whether, and when, such complication has arisen, since, under several contingencies, it may need the application of iridectomy.

Thus the idea of inflammation must be dissociated from that of glaucoma and glaucomatous tension. Though often combined, and the combination then of the greatest importance, yet their co-existence is not essential to the presence of either; and, as a matter of fact, they occur independently of each other every day.*

It is now my constant practice, when defective vision is complained of, to ascertain almost at the first instant the state of tension of the eye. To do so, strikes at once home to the diagnosis. If undue tension exist, there are also its great and peculiar risks, and the question of its relief by a surgical proceeding at once arises in the mind. Though it does not necessarily follow that this must be performed, the scope of inquiry is greatly narrowed. The use of the ophthalmoscope probably soon decides in a positive manner the cause of the blindness, and the details of the case are speedily filled in.

It is easy enough to estimate the tension of an eye, though there is a right and a wrong way of doing even so simple a thing. I may, therefore, explain that *both forefingers* should be used together through the upper lid, which is to be gently closed. One finger steadies the eye by pressing against it with a suitable degree of force, while the other estimates the tension; or rather both together estimate it, when thus used in concert. I tell the patient to *close the eyes gently as if asleep*;

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* Professor DONDERS holds the same view (*vide* HAFFMANS, 'Bijdrage tot de leer van't Glaucoma,' Utrecht, 1861. *See* also GALEZOWSKI, 'Annales d'Oculistique,' Vol. XLVII, p. 252).

and the fingers are then applied to the upper part of the globe, behind the corneal region. If the patient *forcibly* compresses the lids, the mere action of his muscles may cause a momentary tension of the eyeballs as well as interrupt the examination. If the eyeballs are deep-set or small the determination of the tension is less easy. With medical men, the touch is already an educated sense, and a very little practice will suffice to apply it successfully to the eye.

I have long paid special attention to the subject of tension of the globe,* and particularly since it has assumed so much additional importance in the last few years. I have found it possible and practically useful to distinguish nine degrees of tension; and, for convenience and accuracy in note-taking, have designated them by special signs. The degrees may be thus exhibited.†

T represents *tension* ("t" being commonly used for "tangent," the capital T is to be preferred). Tn, *tension normal.* The interrogative, ?, marks a *doubt*, which in such matters we must often be content with. The numerals following the letter T, on the same line, indicate the *degree of increased tension* [the plus sign + not being needed.—W. B.]; or, if the T be preceded by –, of *diminished tension*, as further explained below. Thus:

T3.—*Third* degree, or *extreme tension.* The fingers cannot dimple the eye by firm pressure.

T2.—*Second* degree, or *considerable tension.* The finger can slightly impress the coats.

T1.—*First* degree. *Slight*, but *positive increase of tension.*

T1 ?.—Doubtful if tension increased.

Tn.—Tension normal.

– T1 (?).—Doubtful if tension be less than natural.

– T1.—First degree of reduced tension. Slight but positive reduction of tension.

– T2.— }
– T3.— } Successive degrees of reduced tension, short of such considerable softness of the eye as allows the finger to sink in the coats. It is less easy to define these by words.‡

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* See my 'Lectures on the Parts Concerned in the Operations on the Eye,' &c., delivered at Moorfields in 1847, p. 5; and *ante*, pp. 105-6.

† Since this paper was read, I have simplified the signs, with the concurrence of my friend, Professor Donders, in order to adapt them for general use. The simplified form has been substituted above.

‡ In common practice, some of these may be regarded as refinements; but, in accurate note-taking, where the nature and course of various diseases of the globe are under investigation, I have found them highly serviceable, and they have as much precision as perhaps is attainable or desirable.

It is also to be borne in mind that the normal tension has a certain range or variety in persons of different age, build, or temperament; and, according to varying temporary states of system, as regards emptiness or repletion. Experience will make every one aware of these varieties, which do not encroach on the above abnormal grades of tension. Medical men may understand how important is this matter of the degree of tension by considering how priceless would be the power of accurately estimating it by touch in the case of various *head affections.*

In the very limited time allotted to me, I cannot pretend to do more than glance in the most summary way at what most interests us as practitioners.

The cases of glaucomatous disease in which it is most difficult to appreciate the applicability of iridectomy are those of *very chronic and insidious course* (the chronic glaucoma, and the amaurosis with excavation of the optic nerve, of von Graefe: the simple glaucoma of Donders), where the increase of globe-tension either is slight, variable, and more or less intermittent, or, if it at length comes to be considerable in degree, does so by such gradual steps that the tissues of the eye slowly accommodate themselves to the results of the pressure, and the optic nerve passes through its atrophic changes without any excitement of the vessels, without pain, without any active symptoms whatever. If one eye continues sound, the patient may thus lose most or all of the sensibility to light in the other retina without being aware of it (of course, a similar loss may occur from other causes than glaucomatous tension): and he may often first make the discovery when the better eye begins to fail. More often, however, both eyes fail together, with equal or unequal steps. The slowness of the progress towards blindness, the absence of any urgent symptoms, the fact that vision in the centre of the field frequently remains good to a late period, while the marginal portions of the retina are more and more decaying, often the age and feebleness of the patient, his despondency, and the protracted anxiety of friends, may disincline us from advising an operation, especially if the other eye still sees perfectly. The question of an operation, indeed, often is not raised until the retinal and other tissues have already undergone much change, and when, therefore, less recovery of structure can be expected to follow the relief of tension.

The result obtained is frequently only the retention of what little vision may yet remain, and the patient may still appear, and in fact feel, very like a blind person. During the last five years, I have had the responsibility of advising in very many such cases. In the more advanced stages, I have not felt able to urge the operation strongly, and yet I have recommended it as the only means of saving the little sight remaining. Where there is more sight left to be preserved, the operation is to be more insisted on; but, unfortunately, the patients, not being so blind, are often less disposed to submit to it. The progress of structural changes in the eye, marked by narrowing of the visual field, should induce us to urge iridectomy, and the earlier we perform it, the better chance there will be of deriving improvement: for we cannot recall the activity of nerve-fibres that have undergone complete atrophy.

The sub-acute form of glaucoma—glaucoma with sub-acute inflammation (Donders) —is one in which iridectomy is *to be urged* without unnecessary delay. Its results have been most encouraging, and a large number of cases, in which all glaucomatous symptoms have permanently subsided after its performance, amply attest its value. Did the time permit, I could relate numerous instances of persons thus affected, who, I have no doubt whatever, would long since have been totally blind, but for the timely aid thus afforded them. Here relief to circumocular pains, and an extension of the contracted visual field may be anticipated, while the retina also becomes more acutely sensible in parts in which the perceptions were previously dull. This amelioration may continue to advance for many weeks, even for months or years, subsequent to the operation. It will be great in proportion to the earliness of the period at which the operation is resorted to.

But in the *acute form of glaucomatous ophthalmitis*—acute glaucoma (von Graefe), glaucoma with acute inflammation of the globe (Donders)—iridectomy should be performed *without the slightest hesitation or the smallest delay.* Here every hour is precious, the urgency being measured by the intensity of the inflammation. The loss of sight results partly from the presence of inflammatory products in the substance of, and in front of, the retina, but also from the altered circulation in the nervous structure, and the intense pressure to which it is subjected. The operation relieves from both. The inflammatory state is allowed to subside, and the products of inflammation then undergo gradual, often very rapid, absorption. In addition, the eye is left without that exalted glaucomatous tension which probably preceded the outburst of the acute attack, and formed from the first the essence of the disease. If in any case this acute form of ophthalmitis is absolutely abrupt in its onset, unpreceded by premonitory symptoms (which I doubt), I am still disposed to distinguish it from all the ordinary forms of inflammation, even though equally acute, and to connect it with that state of the nerves and bloodvessels which induces the non-inflammatory form of glaucomatous tension.

It is in the more acute cases of glaucomatous inflammation that punctures of the coats or chambers of the eye had been found beneficial before the introduction of the practice of VON GRAEFE. Such punctures, no doubt, may relieve tension to a certain extent, and for a certain time. They may give ease, and may cause the more intense symptoms to abate. Even without a puncture, the *acute inflammation* may subside, after running a certain course, and destroying sight. But it is most important to notice that, though a puncture may ward off for a time the destructive violence of the inflammation, a sub-acute excitement is likely to continue, relapses to occur or, at any rate, the glaucomatous hardness of the globe to persist, under which eventual loss of sight is inevitable. It is not wise, therefore, to rely on this expedient.

As long as any perception of light remains in cases of acute glaucoma, I would earnestly counsel an immediate recourse to iridectomy. No abatement of the more pressing symptoms from bleeding or any other remedy, no improvement of sight, *while tension continues*, is to be for a moment allowed to weigh against it. And even though all sensibility of the retina has apparently lapsed, I should not quite abandon the hope of rescuing some sight, provided the course had been very rapid, and the total extinction of sight very recent. At all events, an iridectomy would not be even then too late to hasten recovery from the inflammatory symptoms, and to avert the after consequences of a hard and painful, as well as sightless, globe.

So many cases have been published of good recovery by iridectomy, from the otherwise fatal consequences of acute glaucoma, that I need not adduce others, even did time permit. One of the most interesting I have had is that of the coroner for a borough in Suffolk, a lawyer of middle age, who some two years ago, had acute glaucoma successively in the two eyes in the course of a few months. For each he came to consult me; for the first, after about four days, for the second, within the second day, each eye being at the time all but blind. I instantly, in each case, performed iridectomy, and pursued no other treatment. The relief was immediate. The first eye regained an extended, though not a complete, field of vision, the nasal side remaining blind, while with the axis of the retina he could read No. 4 of Jäger (a small type). The second eye recovered perfect sight, and the amendment in both eyes continues, so that he has ever since uninterruptedly pursued all the duties of a very active professional life, and calls sometimes to express his gratitude—a gratitude I feel to be rather due—like that, I rejoice to say, of many hundred other sufferers in various countries—to von Graefe.

The importance of the subject must be my apology, if I now point out some of the common fallacies by which precious time is lost:

1. If the disease be more or less acute, *i.e.*, complicated with more or less inflammation, it is often treated by topical remedies, as hot or cold applications, leeches, blisters, sedatives, or by purges, mercury, colchicum, opium, with low diet. The sympathetic vomiting ushering in the most acute form is mistaken for a "bilious attack," and the essence of the disease quite overlooked.

2. If it presents itself under one or other of its slower varieties, the particular cause is unrecognised, and the patient may be told, and the surgeon believe, that it is only the "stomach" or "a little gout"—formulæ of speech which, however convenient, seem to me to have a good deal to answer for, even nowadays. If it be true, as I know it to be, that no remedies given on any such loose notions can exert any salutary influence on the disease, even if the stomach be in fault, which is common, or the patient be really gouty, which is more rare, while the eye is gradually losing sight through a distension, which only a surgical proceeding can reduce, the sooner a more correct knowledge of the actual condition of the eye is obtained the better for both parties.

3. Patients themselves are often alarmed by the idea of any operation, or they are afraid to take chloroform, or being feeble or old, or desponding, an operation is thought to be "not worth while," or they have a dread lest it should injure the other eye from sympathy. Thus, taking counsel of their fears, especially in chronic cases, where no immediate urgency exists and they suffer little pain, what they regard as the evil day, but what is really the day of relief, is put off, often till it is too late. I have seen this so repeatedly that I must allude to it, even at the risk of appearing tedious.

I shall not easily forget the case of a feeble, dyspeptic clergyman, from Derbyshire, who called on me a fortnight since so altered that I hardly recognised him. Two years ago he was in a deplorable state of despondency from blindness, far advanced from chronic glaucoma; and I had the greatest difficulty in inducing him to submit to iridectomy. He is now able to do his full duty, and is happy and cheerful.

I have alluded, in very general terms, to three principal forms of glaucomatous disease—the slow non-inflammatory, the sub-acute, and acute inflammatory forms. These offer infinite varieties, and are met with in various combinations, which it would be impossible to advert to in detail on the present occasion. But some of them may be specified.

There is an intermittent form, with perfect remissions; and if the attacks are rare, and moderate in degree and duration, they may do no structural damage to the eye during many years. Being excited by temporary causes, they may, in some measure, be guarded against; and it is only if they become frequent, and a continual source of disquietude and danger, that iridectomy becomes applicable. That most interesting phenomenon of iridisations, or rainbow-colours around a candle or light object, is very apt to occur in this form as well as in the sub-acute variety. In simple glaucoma it is uncommon.

There is a hæmorrhagic form, one which I regard as of great and exceptional importance, and which is fortunately rare, since iridectomy is less certainly able to control it, or to save sight. Glaucomatous inflammation may supervene upon a hæmorrhagic condition of the retina, with distressing pain, augmenting tension and decay of sight, and a relapse may occur again and again, after repeated relief following repeated iridectomy, the event being sometimes complete blindness, though some such eyes have been partially rescued. I could relate several interesting cases of this hæmorrhagic form. Glaucomatous tension may also attend certain cases of iritis, whether that form formerly styled *aquo-capsulitis*, or *recurrent* attacks with *synechia* and *choroidal affection*. In many of these I have found iridectomy of the utmost service, but I can only refer to them now.

There are also the complications of glaucomatous disease with cataract, glaucomatous tension coming on in the earlier or later stages of cataract.

An accurate diagnosis is most important here, as the glaucoma has first to be dealt with by iridectomy, and the cataract reserved for a future operation, after the glaucomatous tension shall have long ceased. The glaucomatous element will not admit of delay; the cataract will wait, indeed must, for to attempt to extract a cataract from an eye when in a glaucomatous state would entail great risk of destruction of sight from intra-ocular hæmorrhage. But I have in several instances dealt in succession with the two several diseases with most satisfactory results. Nevertheless, the complication is a very grave one, and the treatment tedious.

For the supposed dependence of glaucoma on various blood-affections, experience affords slight warranty; albuminuria, diabetes, are rare with it; gout and rheumatism far from common. It often occurs in persons of excellent constitution, though most frequent in those whose nervous powers are depressed. Its whole history points rather to its origin in certain states of the nerves supplying the bloodvessels of the eye, but the question is too abstract an one to be now entered upon.

I must now forego all reference to the operative procedure itself for want of time, or I might offer some hints supplied by an extended trial of several methods. I by no means wish it to be imagined to be always simple and free from risks, but these may be avoided by care, and are only what every such remedy is exposed to.

It may be expected of me, however, not to pass over altogether in silence Mr. Hancock's operation, called by him division of the ciliary muscle, and applied, as he informs us in 'The Lancet' of last week, "with most success in keratitis sloughing of the cornea, staphyloma, dense opacity of the cornea (in some cases of several years' duration) and in conical cornea; also, in certain forms of amaurosis, in acute and chronic glaucoma, and in posterior staphyloma and myopia"—a list comprising diseases so widely different from one another, as to suggest a doubt whether a common principle can govern their treatment by the same surgical proceeding.

The incision through the coats of the eye, thus styled division of the ciliary muscle, involves, I believe, the sclerotic coat, a very small portion of the whole ciliary muscle, the ciliary body of the choroid, with the vitreous humor. In many instances, it appears to have evacuated the aqueous humor, while the vitreous humor must always either escape at the moment, or have liberty to drain away for some time afterwards. If it be of the essence of the operation to divide the inner or circular fibres of the ciliary muscle (Heinrich Müller's), then a consideration of the anatomy of the part would show, I think, that the aqueous chambers are likely to be opened. If the humors of the eye escape, tension is, of course, relieved, and if much vitreous humor be lost, it is conceivable that even permanent reduction of tension may result. Experience only can determine whether such an operation may suit certain forms of disease; the proceeding may possibly have advantages in certain cases, although the hypothesis on which it is grounded prove untenable. Meanwhile it seems desirable that the cases in which it is said to have effected so much, and on the strength of which the Profession is urged to adopt it, should be published in greater detail, and with that regard to scientific accuracy which recent advances in knowledge demand. Particularly is this to be wished for, when we are asked to abandon in favour of this incision in glaucoma, the operation of iridectomy, the admirable results of which have now been tested by a wide experience, and guaranteed by many men fully capable of arriving at a sound conclusion.

(*The following is added in accordance with a wish expressed by the Meeting at which the foregoing Paper was read.*) *Extract from the 'British Medical Journal,' October* 11*th*, 1862, *pp*. 381–382.

NOTE ON THE OPERATION OF IRIDECTOMY FOR GLAUCOMA.

The operation is best done when the patient lies on a sofa on his back, with the surgeon standing at his head. I prefer to use chloroform, though I have often operated without it. It should be given so as to render the patient completely passive, for the great delicacy of the operation requires perfect quietude of the eye, lest the steps should not be severally completed in the most perfect way. My own opinion undoubtedly is that there is hardly any person to whom chloroform may not be safely administered, though, it is true, some subjects demand more care in its exhibition than others. The sickness may usually be avoided by taking care that no food be in the stomach at the time, and if it occur during the operation, the steps must be simply delayed while it lasts, not varied in any way. If the sickness is very straining, so as to distend the vessels of the head and face, I usually close the eye, and gently compress it by the fingers on the lid, during the efforts at vomiting. I have not seen any harm happen from such vomiting when the incision has been properly made, not too extensive, and not too far back from the corneal margin.

I always keep open the lids by the wire speculum, which an assistant holds a little forwards if it tends to exert pressure on the globe. It is well for the surgeon to be able to use the right or left hand indifferently in making the incision, as he can then select the most convenient spot. I have always preferred to make the iridectomy nearly or quite upwards, because I believe this direction to be as good as a lateral one in reference to the visual field, and the upper lid then covers the gap in a way useful both optically and for appearance sake. It is, however, rather more easy, on the whole, to make the iridectomy to one side than upwards.

I make the incision in one of two methods, according to the size of the anterior chamber. When there is space enough it is best to use the triangular lancet-shaped blade, inclined at an angle on the flat, and which I believe is used generally abroad, as well as by von Graefe. Having selected a place for the incision, I seize the conjunctiva with proper forceps immediately opposite, and thus fix the globe without making any pressure upon it, or pulling it from its bed. The lancet is then thrust in so as to enter the anterior chamber at its rim immediately in front of the attached border of the iris, and is carefully advanced towards the opposite side so as to form an opening of the required size; and if the opening cannot thus be made as large as is desired, it is enlarged at one angle on withdrawing the blade. When, however, the chamber is shallow, I prefer what I at first always used, namely, a narrow extraction knife, running its point along the rim of the chamber for the requisite extent, and making the counter-puncture much as in ordinary extraction. Thus the instrument avoids the pupillary region and the lens. The operation is more difficult where the chamber is shallow. Whichever instrument be employed it enters a little behind the apparent junction of the sclerotica and cornea, in the sclerotica, and in entering the rim of the anterior chamber, it usually passes across that junction and through a very little of the corneal tissue just in front of the pillars of the iris.

As the instrument used in making the incision is withdrawn, the aqueous escapes, and it is well to let it do so gradually, and to keep the point of the instrument towards the cornea rather than towards the lens. The iris may now be found either to remain in the chamber or to prolapse. If the former, the small* slightly curved iris forceps are to be introduced (closed) into the chamber and made to seize the iris opposite the middle of the incision, about midway between its pupillary and outer border. The iris is then brought outside the chamber and divided with small scissors on one side of the forceps from the pupillary to the ciliary border, the forceps pulling it gently at the same time, so as to ensure this complete division of it. The end held by the forceps is then torn from the ciliary attachment as far as the angle of the incision, and even dragged upon a little, so as to detach it beyond the angle, and then divided with the scissors quite close to the angle. The cut end then retreats within the chamber. The opposite side of the prolapsed part is then seized and dealt with exactly in the same manner. No iris should be left in the angle of the incision, lest the healing process be imperfect, and subsequent irritation occur.

If the iris at once prolapse on the completion of the incision (it is often bulged by the aqueous humor of the posterior chamber), the forceps need not be introduced within the incision, but may seize it outside. The less any instrument enters the anterior chamber the better, for fear of damage to the lens.

If any blood flow into the anterior chamber during the operation, it is as well to allow it to escape before it coagulates. This is best done by inserting a fine scoop within the lips of the incision (not into the chamber) and, at the same time by making, if requisite, slight pressure on the eye by the forceps which holds it. The cornea should not be pressed on, lest the lens receive injury, and, rather than run the slightest risk, the blood may be allowed to remain, as it is very soon dissolved by the aqueous humor, and flows out or is absorbed.

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* The points of the forceps, when closed, should form a perfectly smooth end, so as not to scratch the lens, or catch in the iris on sliding over it.

The operation just described ensures the excision of a complete segment of the iris, from pupillary to ciliary margin, of a width determined by the size of the incision, and which may be usually about a sixth or a seventh of the whole circle.

After the operation, little is usually required beyond seclusion of the eye from light while it remains sensitive, keeping it cool by a wet rag as long as may be agreeable to the patient, together with ordinary attention to the general functions.

In all but a few cases the globe-tension remains permanently lessened afterwards. In some, it returns more or less during a few days, but again subsides as the wound fully heals. In some where it has long existed, or been extreme, it is not entirely relieved, but only much lessened, and here an additional iridectomy may or may not be required, according to the indications afforded by the state of vision. If this seems to be recovering no further interference will be necessary, and, indeed, if the iridectomy have been properly performed in the first instance, it will very rarely have to be repeated. In at least three instances I have known such a supplementary operation completely efficacious in reducing tension to the natural standard, when, from one cause or another, the effect of the original iridectomy had proved insufficient.

XVIII.

FURTHER REMARKS ON GLAUCOMA AND THE RESULTS OF IRIDECTOMY.

By Professor A. VON GRAEFE (*'Archiv. für Ophthalmologie,' Vol. VIII,* 2), *with Notes by Mr.* W. BOWMAN, *in 'The Ophthalmic Hospital Reports,'* 1863, *Vol. IV, pp.* 41 *to* 58, "*Periscope.*"

(The English reader has access to some of the earlier papers by Professor VON GRAEFE on this subject, in the able translation by Mr. WINDSOR, of Manchester, published by the New Sydenham Society. To the present version of a valuable paper containing his more recent views I have added a few notes within brackets ( ).—W. BOWMAN, 1863.)

PART I.

Is immediate operation desirable in all cases of acute glaucoma? At what period of the attack may we reckon on the efficiency of iridectomy? No competent operator may be at hand; should in that case a patient suffering from acute symptoms go a long journey to find one? Professor VON GRAEFE decides that he had better do so than risk delay: that he may do so with safety as regards the eye, though, of course, at an inconvenience; but the urgency in acute cases varies. The urgency does not depend on the intensity of redness or chemosis, nor on the amount of tension or pain, but, *above all,* on the *degree of impairment of sight.* As long as the patient is able to read large print, and the field of vision is not contracted (*i.e.*, if he has not totally lost sight in any portion of the field of the affected eye), the operation may be deferred a few days, if need so require, especially if the inflammation tends to abate, and the sight to improve somewhat under the treatment employed. There are even some cases in which VON GRAEFE would prefer waiting a few days, viz., where the loss of sight is moderate, but the pain extreme, with an inclination to vomit. Here it is well to allay pain first by injection of morphia (gr. $\frac{1}{8}$ to $\frac{1}{3}$) under the skin of the temple, and procure at least one good night, so as not to operate while the patient is under excitement. (I should not delay the operation on this ground, but give chloroform.) On the other hand, perfectly good eyes sometimes lose all perception of light very suddenly from glaucomatous disease, hence styled by VON GRAEFE *glaucoma fulminans* (called apoplexy of the retina before the ophthalmoscope was in use). The symptoms of intra-ocular pressure arise very rapidly—enlarged pupil, flattened anterior chamber, stony hardness of the globe [T3], anæsthesia of the cornea, and violent ciliaralgia. The intensity of none of these symptoms, however, equals that of ordinary acute glaucoma, and yet the sight is lost in a few hours, or sometimes even in half-an-hour. The ophthalmoscope then shows usually a diffuse dulness of the aqueous and vitreous humors, and, as far as we can judge, an overfulness of the retinal veins. There soon appears proportionally very rapid decrease of the arteries and excavation of the optic nerve. This last, in one case, occurred within a few weeks after the attack. It is true (proceeds the author) that the phenomena of vascular excitement may accompany the blindness from the first, but sometimes they follow it in so peculiar a manner that we must regard the onset of tension to have been more sudden and severe than usual, and this either absolutely or relatively. An uncommon rigidity of the sclera on the one hand, or an unusual disposition in the optic disc to yield, or inability of the retina to bear compression, on the other, would alike explain the sudden blindness from a moderate hypersecretion. The explanation is probably this: whether the propulsive power of the heart be too small, or the coats of the arteries diseased, the result will be a ready development of the arterial pulse (impeding the retinal function), and consequently an entire cessation of blood in the retina.

A case of *glaucoma fulminans*. Left eye absolute glaucoma (*i.e.*, having run its course to complete blindness) with cataract. Right eye affected five weeks. Patient stated that one morning, without any warning, a cloud had rapidly come on, with rather violent ciliaralgia, ending in one hour and a half in total blindness. He was sure he could not afterwards see the brightest sunlight. Vascular excitement with lacrymation occurred only after some days. After five weeks, when first seen, the pupil was very widely dilated, humors dull, globe stony hard, no perception of light; and as pain had nearly subsided, no operation was undertaken. Two other cases were more satisfactory; in both one eye was blind from previous glaucoma. The eyes resembled the last, only the media were more obscure. In the first, dilated retinal veins and a normal level of the pupil could with great difficulty be seen; in the second, nothing could be discerned of the internal tissues. In the first there might have been perhaps a remnant of quantitative perception of light (*i.e.*, the mere perception of light and shade, not of objects or colours or even of locality, and vaguely of intensity, which has sometimes been called "perception of shadows," but which may most simply be called "perception of light"). A bright lamp held near the eye was unperceived, but if the light was intensified by a strong lens and directed by the sclerotica on the retina, while the eye was turned sideways, she made such positive statements that I concluded some portions of the retina were still excitable.*

As the blindness was of such short duration, the injection phenomena were only slightly indicated. On the day of the operation (which I performed about eight hours after the blindness began) the patient was able to see the movement of a hand; on the third day he counted fingers. The field of vision proved to be very irregular, with many and great interruptions, caused by the amount of hæmorrhage of the retina. They disappeared gradually. With their absorption the sight became very satisfactory (type No. 3 at 10″, and visual field normal), and has remained so until now, *i.e.*, for the space of a year and a half.

In the other case operated on on the third day, no quantitative sensibility of light was left; it was said to have become extinct during the first two hours of the disease. On the second day, violent injection with somewhat serous chemosis appeared. The results of the operation were only gradually manifested and remained imperfect. No sensibility to light could be detected until the second day after the operation, when it appeared, at first only slightly, and in one direction, upwards and outwards, but afterwards gradually increasing. The patient was not able until a week afterwards to count fingers in a small portion of the field. Uncommonly numerous and large retinal ecchymoses appeared. In two months the recovery was so complete that the patient was able to read with convex glasses (No. 6 at 10″), though at the same time there existed an indistinctness of the eccentric sight inwards (20°), and a peripheric defect (40°), in the same direction. The optic nerve was slightly excavated and rather whitish. According to subsequent communication by letter, the sight has decreased lately from No. 6 to No. 8, and has remained for nearly a year in this state. We see, therefore, that iridectomy performed on the *third* day of glaucoma fulminans is by no means complete in its result. I consider it my duty to dwell upon this, because it goes to limit, in a certain degree, that which I have previously stated.

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* It is by no means always easy in cases of glaucoma to ascertain whether there be still a remnant of sensibility to light or not, especially if this remnant has its seat in a very small and eccentric part of the field. I may here mention a remarkable fact, viz., that I have frequently had patients who were unable to distinguish the light and shade of a brightly burning lamp, and yet could at times catch a glimpse of things at a distance. I considered these statements illusions which often happen with the blind, until some remarks of one patient fairly startled me. On accurate examination I found that he had a very eccentric field of very small size; at 12 feet distance it had a diameter of six inches by eight inches. Within this circle the patient could clearly distinguish the movements of my hand and even count my fingers. I then repeated the examination with the lamp, and found he was quite unable to see it. I then, by means of a piece of ground glass, diffused the light of the lamp and brought it to bear on that part of the field of retina which I had ascertained to be functionable. The result was negative. On a daylight examination of the patient I met with no better success, and could only obtain positive statements when the back was turned to the light and the object placed in the small field of vision. The explanation of this, which I have observed in four or five other cases, is still a problem to me. The size of the field cannot be the sole cause, as, however small it may have been in the cases I have mentioned, it was always strongly lighted.

Judging from the cases I mentioned in my former papers one might feel inclined to depend upon the complete effect of an operation performed a fortnight after the beginning of the blindness, even though there might appear to be some advantages in favour of its performance during the first few days, but I then pre-supposed that there was still quantitative sensibility to light, which is not the case in the examples I am about to mention.

To guard against mistakes in prognosis I give here the fourth case, in which operation after fulminating glaucoma had hardly any effect upon the sight, and was in the end of no benefit whatever. About the end of 1856, Madame N., a lady from Silesia, 55 years of age, became suddenly blind of the right eye. In a few weeks inflammation appeared, accompanied by severe ciliaralgia. The November of the following year she was driven by continuous pain to consult me. I found absolute glaucoma of the right eye, with commencing cataract, and as the tension was very great, I performed iridectomy for the purpose of soothing the ciliaralgia. Next month the cataract was complete but the eye itself slacker, and I dismissed my patient with rules of conduct regarding the still sound left eye, charging her to continue the treatment according to my injunctions, until she perceived the appearance of any suspicious signs in that eye. Between that time and the 16th of December, 1860, the left eye remained sound, and failed in evincing any precursory signs of a glaucomic attack. On the morning of the said day, however, the patient, who had suffered for some time from rheumatic pains in different parts of the body, but had slept the past night perfectly well, felt, while at breakfast, a grey mist come suddenly over her left eye, increasing so rapidly that in an hour she could only distinguish the outlines of the largest objects, and by noon it had become total blindness. In the evening the eye began to pain her and the next and following days, according to the attendant's statement, redness and tears appeared, accompanied by violent ciliaralgia which deprived the patient of sleep. All these symptoms continued in spite of copious bleeding in the neck and local drawing of blood, which was ordered by the surgeon of the place. When I saw the patient again for the first time knocked up by the journey and the pain she had gone through, I found extreme mydriasis, the iris reduced to a narrow ring, and discoloured to a greyish hue, anterior chamber very shallow, upper half of the cornea anæsthetic, aqueous humor clouded and dull, as was the cornea on its surface at the lower part, the back of the eye indistinct in consequence, the globe extremely hard, slight injection of the anterior ciliary vessels, few tears *and no sensibility to light at all.* The diagnosis pronounced it to be glaucoma fulminans and I performed iridectomy the same day. In a few days the ciliaralgia had entirely disappeared, the aqueous humor and cornea were considerably clearer, the sensibility of the cornea returned, the tension of the eye diminished, and the iris was somewhat broader and less discoloured. Especial observation was directed towards the existing degree of sensibility to light. The first four days after the operation, the result was negative, on the fifth day, however, a trace of light appeared, though only within a narrow limit, upwards and outwards, and the statements of the patient were so uncertain that I still remained in doubt. But all doubt was removed, when, in a few days, the patient was able clearly to distinguish the light and shadow of a brightly burning lamp at one foot distance, the lamp being held about in the direction of the optic axis, and inclined a little outwards on one side. This sensibility to light went on increasing in a very slight degree until about the third week after the operation. The patient could then discern a moderately bright lamp at three feet distance, the field of vision lying outwards in the form of a slit, which though too small to be measurable, corresponded to an opening of 20°. I examined the eye with an ophthalmoscope towards the end of the second week, and found the refractive media perfectly clear, a deep excavation of the optic nerve, on the edge of which the veins were very much displaced, small arteries without pulsation and a whitish discoloration of the disc. There were enormous retinal ecchymoses in various parts of the eye, partly in the inner plane of the retina (where they were darkest, in the form of large opaque cherry red flakes completely covering the retinal vessels), partly along the vessels themselves (in irregular stripes or spots forming large figures where the vessels are divided), and partly also behind the visible vessels, in the shape of round, light red, transparent spots.* At last suffusions appeared, more connected, of a bright red colour, but not opaque, which, judging from their free diffusion, and their relation to the coarser choroidal veins, originated on the surface of the retina. Though the pigment layer was visibly covered by these extravasations, the choroidal veins still formed sharp edges in many places; this, as well as the great resistance offered by them to a hæmorrhagic suffusion on the surface of the retina, is explained by the projection of the vessels, the coarser ones especially on the inside of the choroid. In the corpus vitreum there were some hæmorrhagic flocculi which attracted my notice by their mobility and tendency to be pushed to the back of the eye. I still hoped that with the disappearance of the ecchymoses, the perception of light might increase, but the reverse was the case. The slit-shaped field narrowed, and in six weeks after the operation all sensibility to light was extinct, while the ecchymoses had decreased and in parts had disappeared altogether.† Atrophy of the optic nerve became more and more apparent. The conclusion arrived at is, that iridectomy had abated the inflammation, but had done nothing for the blindness. This case clearly proves, when opposed to the one before quoted, that it is expedient to act with all possible speed when dealing with cases of glaucoma fulminans. The violent hæmorrhage which follows upon iridectomy in all cases of glaucoma fulminans argues an enormous stagnation of blood taking place in the veins from the beginning of the disease. Whether the total blindness is to be ascribed more to the disturbance of the circulation, viz., the interrupted entry and discharge of blood, or whether it is caused by direct compression of the conducting fibres, is a doubtful point, especially in cases of acute glaucoma.

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* This is the most common form in cases of acute glaucoma after iridectomy.

† The suffusion on the outer plane of the retina, and the light red spots on the further side of the vessels, vanished first, while the dark red patches between the retina and hyaloid went away more slowly. These suffusions disappeared by becoming gradually lighter and the spots thinned by dissolving into small dots and groups of dots; but the patches went away by very slow concentric decrease, the

If we decide in favour of the latter cause we must duly take into account the uncommonly rapid formation of a deep pressure-excavation; however, the two views are so closely connected, that I doubt whether an impartial decision can be arrived at.[*]

centre preserving its dark opaque appearance and only the edge, as it melted away, becoming of a lighter colour. I have more than once, under like circumstances, watched the various modes of disappearance, giving them special attention when to pre-existing chronic glaucoma was added commencing scleral-staphyloma, with highly inflammatory paroxysms. Then the ecchymoses take a tumultuary character, and even spread over the surface of the choroid.

[*] (The exact period of the iridectomy is not stated in this case, but it was probably within a week. Had not tension returned with the renewed loss of sight? It seems also probable that some tension (simple glaucoma) may for some time have preceded the acute attack, though unobserved by the patient. This at least would afford a clearer explanation of the deep excavation of the disc, with great displacement of its veins, and white atrophy at so early a period, as, say, the end of the third week from the acute attack.)

PART II.

TREATING OF THE DISADVANTAGES BOTH REAL AND SUPPOSED OF IRIDECTOMY IN CASES OF GLAUCOMA.

The more the value of iridectomy in glaucoma is acknowledged and its use extended, the more urgent becomes the duty of dwelling upon its possible deficiencies, and it will only tend to make this method prosper the more, if we look at it from all its points of view, and examine it on all sides, by the light of considerable experience. I will therefore proceed to make a few remarks upon the subject.

1. I have formerly mentioned cases in which iridectomy having been successfully performed on *one* eye, the disease appeared in the second eye shortly afterwards. From these cases, which were then very rare, I merely concluded that the arrest of the process in one eye could in no way prevent the transference of the disease to the other, and that therefore we ought not to allow the existence of any sympathetic relation between the two affections, but rather say, that they may be referrible to a common cause, acting on each eye, independently of the other. In a few years, however, my observations on these cases multiplied to such a degree, that I ascertained, and can uphold the fact, that iridectomy, when performed upon one eye, may tend under certain circumstances to accelerate the process of disease in the other. The grounds upon which I make this assertion are as follows :—

Out of all the cases on which I have operated when in the first stage of glaucoma, there are forty-three, in which the second eye was, at the time of the operation, either quite untouched by the disease or else in the premonitory stage. In nine cases out of the forty-three the second eye was attacked by violent glaucomatous inflammation four weeks after the beginning of the disease in the first eye, and a fortnight after the operation. According to this we see that the second eye has been attacked quickly in more than one-fifth of the cases; this is very different to what we have observed in case of no operation. Generally in cases of inflammatory glaucoma, such rapid succession is exceptional, as I only recollect five cases in my practice where I had not performed iridectomy in which the second eye was attacked before the end of the month.* By means of questions put to the many incurable patients who came to me with complete inflammatory glaucoma, I ascertained that the succession of the second eye took place, with few exceptions, many months or even years later. This agrees with the opinion of most of those of my colleagues who have directed their attention to the point in question. Although not able to make an exact statement I know that those five cases, in which rapid succession took place without operation, are taken from a total of eighty patients whom I had seen during their first glaucomatous attacks. This disproportion is so remarkable that we can hardly attribute it to mere accident.

It will aid the comprehension of the circumstances under which iridectomy may have accelerated the succession in the second eye, if we remember that the eye evinced precursory symptoms in seven out of the nine cases of rapid succession above mentioned, so that in two only was it quite intact; while in the total of forty-three cases before cited, there were twenty-four in which the second eye was quite sound. Judging by this, we should say, that the acceleration of succession is most peculiar to those cases of acute glaucoma in which the second eye shows commencing symptoms; if the eye, however, is sound, we had better not decide for certain, on account of the small number of cases in point, and because the disproportion is not so marked, for in the first instance it is one to twelve, in the last more than one to three. According to this the subduing of the glaucoma in the one eye may promote, under certain circumstances, the disposition to disease in the second eye, and thus a relation must be supposed (quite the reverse of sympathetic), namely, a tendency to move from one eye to the other. This finds an analogy in other classes of inflammatory diseases of the eye, for instance, in certain forms of keratitis.

To avoid any misunderstanding, I must remind you that the aforesaid refers only to the use of iridectomy in the first stages of inflammatory glaucoma, for I have observed nothing which would authorise me in drawing a like conclusion with regard to its later periods; on the contrary, I am still of opinion that the degeneracy of a glaucomatous eye (especially the ectasias which are accompanied by violent ciliaralgia or intra-ocular bleedings) disposes the second eye to the disease, in a degree difficult to be ascertained, though certainly over-estimated by many, and that, therefore, it will be found better for the second eye to arrest the process on the first eye by some means or other. These facts need not prevent an intelligent practitioner from making use of iridectomy in cases of acute glaucoma, but only serve to recommend to him some degree of prognostic circumspection. When I operate on patients for acute glaucoma, I always inform them of the possibility of the disease speedily attacking the second eye, so that if this actually happens they are not taken by surprise, but sometimes even gladly welcome the acceleration of the second operation of which they have already experienced the success on the first eye.*

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* N.B.—A case of this kind instructive, moreover, in other ways, has lately been mentioned by PAGENSTECHER and SAEMISCH ('Clinische Beobachtungen aus der Augenheilanstalt zu Wiesbaden,' first vol., pp. 31–34; 'Clinical Observations at the Ophthal. Institute, Wiesbaden').

2. Numerous observations have been addressed to me by some of my colleagues concerning the *formation of cataract*, after the operation for glaucoma. Now the question naturally arising is this: is cataract brought on solely by the opening of the capsule from an imperfect operation, or can it form without this cause? A certain disposition to cataract is peculiar to glaucoma, and we cannot deny the fact that, were once such a tendency to gain ground it might be increased and hastened by the renewal of the humour and the attack on the circulating system of the eye. Indeed, I have observed in cases of immature cataract when I performed iridectomy, preparatory to extraction, that the cataract matured very rapidly, though the capsule had not been wounded.

In deciding this question we abstain from all theories and inferences, and judge merely from the results of practical experience. Among more than 400 cases, upon which I have operated for glaucoma, I saw only one eye† in which cataract formed immediately after the operation, and in this case the capsule had been hurt (owing to the excessive unruliness of the patient), as was proved to a certainty on an after examination. In a few cases (say three or four) upon which I have operated in the later stages of glaucoma, cataract has developed itself in the course of years, but as, for months after the operation, the lens system was perfectly sound and the type of formation resembled the cataract of old age, there was no reason to think that it was the consequence of the operation. On the other hand, I have observed in a considerable proportion of cases of chronic glaucoma, when I have operated during considerable dulness of the lens, that cataract was much more rapidly developed after the operation than before. This agrees with my experience above mentioned of simple immature cataract.

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* (My own experience mainly accords with this. Iridectomy has appeared to me to excite the other eye chiefly where this other was already inclined to inflame; where, with acute glaucoma in the operated eye, its fellow evinced doubtful increase of tension (T1 ?), or some conjunctival or ciliary injection. Hence, in such cases unusual care should be observed during the convalescence to avoid too early or too sudden exposure to light or return to work, especially if there be photophobia or any manifest irritability. Much will probably depend on the course taken by the wound; the sooner and the more smoothly it heals, the less the risk. I have always regarded whatever tendency iridectomy may have to excite sympathetic disturbance in the opposite eye to belong to it as to any mere wound. So far as it is a temporary disturber of the vessels and vascular and sensitive nerves involved, it may arouse sympathetic irritation. In so far as it relieves glaucomatous tension and sets forward the ocular tissues, and especially the internal vessels, on a course of recovery from their diseased state, it can hardly be otherwise than salutary to the fellow eye. So long as glaucoma in one eye is complicated with inflammation, the other eye is more inclined to sympathise, and this inclination lessens as the first affected eye becomes quiet, either by iridectomy or any other cause. The wound of iridectomy itself, though attended by a relief of intra-ocular tension, may sometimes prove a temporary excitant to the other eye, requiring guarded treatment until it becomes quiet. This, however, manifestly constitutes no argument at all against iridectomy, but only for careful management of the convalescence and for a prudent word of warning to the patient.)

† Of course I am speaking only of uncomplicated glaucoma. In cases where glaucomatous tension has resulted from circular or total posterior synechia, the formation of cataract following on the operation takes place in a far greater degree.

It has sometimes fallen to me to extract matured cataract at a later period from eyes attacked with chronic glaucoma. As far as I have observed, not one, of all the eyes upon which I have operated in the first stage of acute glaucoma (the lens being sound), has become cataractous. Many of those patients, however, suffered in the other eye with consecutive cataract, accelerated by complete or increased glaucoma. Experience therefore proves that we are right in this conclusion, viz., that iridectomy, while it subdues the glaucoma, decreases also the disposition to cataract, which is connected with that disease.

Should it ever happen that after a considerable time an eye which has been operated on for acute glaucoma becomes cataractous we should deny a direct relation between this disease and the iridectomy, because this happens so very rarely, and the cataract did not appear until so long afterwards. Cataract is by no means uncommon at an advanced age, and it may be that the previous glaucomatous process causes a first disturbance of the nutrition of the lens, while as yet no dulness can be traced. Therefore, when, shortly after, *iridectomy cataract is formed in a previously sound lens, the cause must be assigned to a solution of continuity of the capsule and not to the iridectomy.*

We are not, however, bound to maintain that this damage must necessarily have consisted in a direct wounding of the capsule by the instruments inserted into the eye. It is very probable that in consequence of a sudden discharge of humor (which sometimes in case of glaucomatous tension spirts out like a fountain), a spontaneous rupture of the capsule might take place. It is partly from fear of this, and partly also to prevent a sudden overfilling of the vessels, that I have always advised that the humor should be allowed to flow out as slowly as possible; this can be effected by laying back the lancet as far as is necessary. I have had patients brought to me who, after they had undergone iridectomy, had marginal cortical opacities just within the capsule, corresponding to the peripheral part of the artificial pupil, which had formed, as the several operators stated, soon after the operation, while the rest of the lens had remained perfectly clear for years in each case. The opacity was most intense near the equator of the lens, and lost itself in the form of a broad stripe, in the immediate vicinity of the accessory pupil. Not the least irregularity was to be discerned in the anterior capsule. Although this statement does not forbid the supposition of a previous wound, yet the time, place, and stationary character of the opacity impressed me greatly, and I thought that a rupture near the equator might have taken place; it was possible that the rather rapid diminution in the thickness of the capsule at this place, and the sudden projection of this part of the lens-border towards the wound during a rapid discharge of aqueous humor, might dispose to such a bursting. The fact that the dulness of lens is local only, arises most likely from the communication being only between the outer border of the lens and Petit's canal. This, however, is but a supposition, and there is much more ground for the idea that the capsule has been hurt by an instrument, than that it has broken spontaneously. (It must be a faulty operation which complicates iridectomy with a direct wound of the capsule. I have, however, seen cataract follow the operation, from pressure exerted on the lens through the cornea, in endeavours to press out blood that has flowed into the anterior chamber, and so disguised the steps of the operation. If this latter inconvenience arises it is sufficient to open the lips of the incision while gentle pressure or traction is made on the globe. I have several times performed iridectomy for glaucoma occurring *in the course of cataract*, and on several occasions have ascertained positively that there was no acceleration of the cataract, sometimes I have thought, a retardation of it. On one occasion I purposely pricked the capsule in three or four places after excising the iris—my object being to render an incomplete cataract mature at an earlier period—but it had no effect beyond leaving specks of opacity where the needle had penetrated, and at the end of a year the rest of the lens was no more opaque than before.)

To secure the exact performance of the steps of the operation especially in cases where the anterior chamber is very shallow, and the pupil widely dilated, I consider a bold *fixation* of the globe (which is best performed with a simple hook forceps) to be absolutely necessary. Although I, for my part, always follow the principle of fixation in all operations on the eye, yet I can quite understand the objections raised against it by some when applied to certain cases, especially that of extraction by flap. Here the question may be looked at from two points and the decision arrived at be twofold. There can be no doubt, however, as to the advantage of fixation in operation for glaucoma. The space allowed for the play of the instrument is often very limited, because we ought to make a point of excising the iris in proper breadth up to the ciliary insertion, and therefore to make the inner wound quite at the rim of the chamber,* but still without endangering the lens capsule. This is very precarious if the globe is at all unsteady, and, indeed, is considered difficult even by the most skilful operators. The fixation of the globe affords greater safety in other respects, however, for instance, in the discharge of the humor. It is only possible with a perfectly steady globe to lay back the lancet-knife skilfully during the gradual escape, so as in some measure to prevent a sudden gush.

I will now return, in a few words, to the subject of the *direction of the iridectomy.*

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* My colleagues are now quite agreed as to the importance of this rule in glaucoma, and ARLT has lately been urgent upon it with good reason. I have treated this mode as opposed to common iridectomy in my first publication on the subject ("Note sur la guerison de glaucome addressé a l'Institut de France") and also in the 'Archiv.' (Bd. iii., 2, pp. 548 and 549). At the same time I must confess that I have known many operations for acute glaucoma to be successful, although the excision was not performed in the prescribed manner. But, as in other cases where the glaucoma was of longer standing, the result under the same circumstances, was unsuccessful, so as to render the repetition of the iridectomy necessary, the rule of fixation has been established and is of great importance, especially in chronic glaucoma, and in the later stages of acute glaucoma.

Where cosmetics are to be considered, I proposed, as also did Bowman, independently of me, that iridectomy should be performed upwards. Moreover, as regards optics, we ought to form the opening upwards, because the irregularly refracted light has, in that case, the least chance of penetrating; besides, the useful pupillary space and the circles of diffusion beyond the limits of accommodation are enlarged to the least extent by this mode of operating. I should not, however, urge the adoption of this direction for the pupil, unless I had reason for it in the particular case, as it is decidedly more difficult of execution, especially in cases where the anterior chamber is very shallow, the iris reduced to a narrow circle and the eye itself very restless. If, when the eyelids are forced apart, the contraction of the orbicularis offer any resistance, however fruitlessly, the globe always has a tendency to escape upwards, and the compression acting upon it becomes naturally stronger, if the hook forceps roll the globe downwards in opposition to this tendency. If this resistance renders the operator's hand unsteady, so that he does not drag the globe down low enough, he is very likely to fail in attaining that position, in which alone proper command over the instrument is possible and either the knife does not enter the chamber at its rim, or else it endangers the lens-capsule by not entering slanting enough. If, on the other hand, the globe is pulled down in the proper manner, the operation will most likely be got through with safety, though at the same time the amount of compression causes the humor to discharge with violence, a fact which deserves consideration.* The appearance of the pupil need not be considered in the greater number of patients, on account of their advanced age, and the optical question is also of little consequence when compared with the chance of risking the general result of the operation. Indeed, the importance of these points in many cases disappears altogether on account of the incurable degree of blindness present. As a rule I should advise the substitution of the *inward* direction for the upward, especially in case of incompetent assistants, if the disease presents many difficulties, or if you yourself have had little practice. You are more likely by this means to avoid wounding the capsule. The reason why I revert to this point, is that excision upwards is frequently practised, abroad especially. (I venture to advocate the upward iridectomy *as the rule* on account (1), of the better appearance afterwards; (2), on optical grounds; (3), on account of the cicatrix being in a better situation under such contingencies as are noticed in the following section. The objections to it on the score of greater difficulty of performance hardly apply when chloroform is exhibited. If, however, the operator is inexperienced, he may make the horizontal iridectomy better than the vertical.)

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* The hyperæmias occurring on the sudden decrease of tension, are very serious in glaucoma. It is not so much the violent hæmorrhage into the anterior chamber as the wide-spread retinal ecchymoses, which creates anxiety. I have seen the latter very conspicuous in acute cases, where the humor discharged itself very violently.

3. There is a peculiar form of cicatrization of the wound after iridectomy has been performed upon glaucomatous eyes, and to this I have for some time directed my attention. Although in general one does not find any scar at all, or at any rate only a very narrow, close, homogeneous scar-substance after linear incisions made by a lancet or cataract knife, it certainly is the case that in one series of glaucomatous eyes, the edges of the wound do not meet, and a kind of web is formed which remains for some time imperfectly closed, and is subject to bulge. When closely examined through a lens, you discover some rather thick scar-fibres stretched in a diagonal direction across the slit of the wound, the interstices being filled up by a thin, transparent, membranous substance. This substance gives way to the intra-ocular pressure and is forced through between these strings, thus dividing the slit into divers transparent blister-like prominences. Generally this substance is periodically broken through, the aqueous humor enters under the conjunctiva, and so forms a serous elevation of the latter from the episclera. This may happen many months after the operation; indeed, I have known cases in which, two years after the iridectomy, the aqueous humor flowed into the sub-conjunctive tissue, and possibly also through the thin membranous substance. The eyes affected generally remain unnaturally soft, but the anterior chamber has about its usual contents.*

It must not be thought that this form of cicatrix, which for shortness sake I will call *cystoid*, is connected with any reaction after the operation. When the eye is examined, a week or ten days after the iridectomy, there is hardly anything about the wound worthy of notice, but it first shows itself at a later period, when the patient leaves the hospital and when the natural force of tension begins to act more strongly. Such cystoid scars may afterwards become the cause of disagreeable accidents, as I shall presently explain. I have noted this formation of the cicatrix, in its higher and typical development, in about one-fifteenth, and in its lower degree, in more than one-fifth, of the eyes operated on for glaucoma. It generally appears in those cases in which symptoms of increased tension were very marked before the operation, and also when glaucomatous excavation of the optic nerve is added to previous scleroectasia posterior. I soon ascertained that this anomaly stood in causal relation to the increase of tension in such a way that the increased pressure would in some measure derange the usual condensation of the cicatricial tissue, and be followed by bulging. I could not suppose it to depend solely on the sclerotica having been involved, for I incise this part in making all marginal artificial pupils, while among many hundreds of cases I have observed this form of cicatrix only where there has been glaucomatous tension. It does not appear either with small scleral wounds in healthy eyes if a little attention is given to them while the wound is healing. It must be allowed, however, that when the incision is made through the cornea, such an anomalous formation of scar is not observed, and that therefore the scleral puncture is the *causa sine quâ non*, if not the *causa efficiens.* We need not be surprised at this, when we consider the great difference between the healing process in the cornea, and that in the sclerotica as regards manner and speed. Were this cystoid cicatrization universal it might aid us in coming to a conclusion concerning the *modus operandi* of iridectomy. The continued escape of the aqueous humor through the scar tissue might lessen the tension in the same way as a corneal fistula. But as in the greater number of operation cases, no such peculiarities in the scar tissue are discoverable, and as, on the other hand, the process of healing in cases of cystoid scar formation offers no advantages over those of the ordinary process, we find it impossible to come to a decision; and, in spite of the many suppositions which have been raised concerning it, the theoretical part of the question has not yet been solved. One thing is certain, that the slow filtering of the aqueous humor causes a greater decrease of tension than we could possibly obtain by the common process of healing. A mere touch of the globe gives proof of this. It is true at the same time, however, that in by far the greater number of cases there is no necessity for such a great decrease, and the usual degree is sufficient. It is a question whether in some cases of chronic glaucoma, with exceedingly hard globe, a natural process is not to be perceived in the cystoid formation of scar; this, however, I leave undecided. In the lesser degree of cystoid formation of scar, the web between the strings became closer in most cases some months after the operation; with this the flow of aqueous humor under the conjunctiva ceased, the slight bulge decreased, and the result was a moderately normal closing of the wound. The eyes in question showed slight symptoms of conjunctive and sub-conjunctive irritation, with regard especially to the wounded part, but no serious disturbance arose therefrom. With the higher degrees, however, it was different. In most cases everything remained unchanged for six months, a year, or still longer, or the ecstasia even increased in circumference. In some cases the eyes suffered during the whole time from conjunctival injections, and were sensitive to external injuries. The closing substance did not thicken until after the period above-named. I have lately seen cases which have been very much aggravated by a bulging cicatricial tissue, and if the irritation is not properly attended to it may go on to suppuration. With increasing sub-conjunctival swelling, and a variable amount of pain, the part affected assumes a yellowish tint, hypopyon occurs, then secondary suppurative iritis, passing sometimes even into panophthalmitis.

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* A little attention will suffice to distinguish this form of cicatrix from that which ensues when the iris is only partially removed. I have already protested against this mode of proceeding, though I know it to be much in favour with some. We are not here talking of the vesicular intervening substance but of a little prolapse of the iris, which is often separated by the cicatricial fibres; then the aqueous humor does not filter through for so long, because the iris tissue grows so rapidly as to be forced into the track of the wound, and so stops it up.

A master turner, of Berlin, about 50 years old, had lost one eye through a reclination nearly thirty years before, while the second eye had become weaker by degrees and evinced symptoms of chronic glaucoma, with commencing dulness of lens. I performed iridectomy, and the result was first a cessation of this, and subsequently an improvement in the sight, but the wound scarred over in the manner described. Nine months after the operation the aqueous humor was still filtering under the conjunctiva, and the globe was soft. One year after the operation the patient, who, contrary to my advice, had till then neglected to come to me, came to the "Polyclinic" with all the symptoms of a diffuse, purulent iridokeratitis, proceeding from the wound substance. This latter was yellow; the iris also presented a yellowish discoloration and was swollen, and there was severe chemosis of that peculiar pale yellow appearance, which is so characteristic of commencing panophthalmitis. The total destruction of the eye was, of course, inevitable. This is, however, the only eye which I have seen destroyed by secondary occurrences in case of cystoid scar, and most likely this one might have been saved by proper treatment. Two other cases were rendered critical through local suppuration of the scar, one six months, the other nine months, after the operation. Though there was strongly-marked purulent iritis in these cases, they were both saved by means of lukewarm poultices, alternately with compressive bandages, atropine drops, and once a rapid mercurialization. In a fourth case, the conjunctival irritability which followed each discharge of humor became so troublesome to the patient that I thought it necessary to put a stop to it by taking off the projecting substance. These and a number of other cases, which I might quote, go to prove that this form of scar presents very decided disadvantages, but only problematic advantages, and that, therefore, it is desirable that it should be counteracted.

I wish to draw attention to the following remarks :—

(*a.*) Those eyes which have a tendency to cystoid scar formation (which tendency is marked at first by the more protracted discharge of aqueous humor under the conjunctiva while the symptoms of the intervening substance develop themselves later) must be guarded for a much longer time than other eyes from external injuries, especially against the effects of tension, and they must be subjected to a periodical compression.

(*b.*) A light compressive bandage applied for the first three or four days after the operation, is generally found useful as a prophylactic.

(*c.*) If the form of scar is marked in any high degree, the question is whether or not it may become troublesome. In the latter case I advise that it should not be counteracted, but that the patient should be carefully watched, so that all possible dangers may be averted in time. In the other case I should recommend a healing of the wound by artificial means. I must here warn you against the application of caustics; as, though it is true, that if used in very great moderation, inflammation need not necessarily follow, yet a stronger application might very often bring on serious irritation, caused by diffusion of the caustic. The best method is the following:—The globe being well fixed, take off the bulging substance with a narrow-pointed knife, as in a small prolapsus iridis, so that after the opening and collapse of the membrane, the cut is finished with the scissors. Even after this little operation great care is necessary, a light compressive bandage must be put on, and several days of strict quiet be procured for the patient, otherwise an inter-substance, inclining to bulge, may again be formed. At the same time I believe that time, and the removal of the glaucomatous tension will do much to lessen this tendency.

(*d.*) When once suppuration has set in, the best time for ablation is over, as the injury and access of air only hastens the suppuration. The best method of effecting a cure is this:—Use luke-warm poultices alone at first, then alternately with compressive bandage, drop in atropine and in case of purulent iritis, try rapid mercurialization. (Every two hours a friction of $\frac{1}{2}$ scr. mercury ointment, with $\frac{1}{2}$ — 1 gr. calomel, until the commencement of salivation.) We are justified in putting the question, whether in this undesirable scar formation which always causes in some per cent. of the cases, irritable disturbance of one kind or another, we ought not to give up the puncture of the sclera and adopt that of the cornea? I have already stated that the direct cause is the dominant increase of pressure, the necessary medium is the peculiar manner of healing of the sclera wound. A skilful operator may attain the desirable peripheric situation of the inner wound, by inserting the knife in an abrupt direction on the edge of the cornea, and by laying it back in a slanting direction as soon as it has penetrated into the inner chamber. But if, on account of a high bridged nose and flat anterior chamber, it is necessary that the operation inwards be performed with very curved instruments, we are not so certain of success, and in the fear of entering the wound too abruptly, we may make the incision too far within the corneal margin. As this point is worth consideration, and as by careful after-treatment the evil effects of a possibly bad formation of scar, may be very much diminished, I do not, in the greater number of cases, wish to give up my formerly advocated place for puncture, one millimetre away from the edge of the cornea.

(*Cystoid Cicatrix.*—This is highly deserving of attention, as it is not uncommon after iridectomy for glaucoma. I have seen it chiefly where, from long existing tension preceding the operation, the sclerotica may be supposed to have lost much of its natural elasticity, and where a slight excess of secretion and consequent tendency to tension after iridectomy may be peculiarly apt to act on the new material of the scar, and to stretch it. Undoubtedly it does not occur after wounds involving the cornea only, and hence if the marginal iridectomy could be as effectually performed *per corneam* as *per scleroticam*, the former might be preferable. I have made some attempts in this direction, but this is not the place to describe them. I am also not certain that in some instances, at least, the distension and thinning of the scar may not in the end prevent the injurious consequences of tension by providing an elastic yielding place. It is certain that even after the most perfect iridectomy the globe has sometimes a tendency to tension mounting to T1, a degree so much less than that which preceded the operation, that the internal tissues tolerate it, and the glaucoma remains arrested. It is in such instances that I have mostly witnessed the cystoid scar, and have regarded it as probably useful as a sort of safety valve. Generally, however, even with the cystoid scar, the tension has long remained somewhat in excess (T1); and, contrary to Von Graefe's observations above, I have hardly ever found the tension less than normal (-T1), even when the vesicle was very large and thin and had existed for a long time. I have thought that in such instances, the distension had gone on gradually to such an extent that at length, as in conical cornea, it came to offer much less resistance to the escape of aqueous humor than at first, and so the tension was brought to an equilibrium. Probably it often happens that by degrees the tendency to over-secretion itself lessens. I have not seen the vesicle discharging itself by an open orifice; nor has it been the seat of any serious inflammation, far less the starting point of ophthalmitis, which I should regard as quite an exceptional, and as it were an accidental, complication. I have, on some few occasions, treated the pellucid vesicular cicatrix by fine puncture with a broad cutting needle, repeated at more or less frequent intervals, and this practice I can recommend where there is any appearance of an obstinate return of tension. The puncture should be effected without pain or irritation and without wound of any vessel, and the surgeon should only see a little trickling away of the aqueous humor. Occasionally in simple and sub-acute glaucoma, a temporary augmentation of tension (T1 or T2) from some passing cause recurs some time after iridectomy had apparently quite allayed the disease. Such tension is often harmless and disappears under simple treatment, but occasionally it seems more threatening and is attended by a little congestion and by ciliary pains. I have found it yield to a single puncture of a cystoid cicatrix or to a repetition of punctures. The cystoid cicatrix evidently afforded a ready vent of a salutary kind, while it had probably itself resulted from some unusual tendency to return of tension in the particular case.

I can call to mind two, if not more, instances in which after an operation for cataract performed without any idea of glaucomatous complication, the cicatrix gradually assumed, in a marked degree, the cystoid character. Several years after the operation when these patients were last seen, the vision remained good. I believe a tendency to glaucomatous tension had been the cause of these bulging cicatrices, and had been also prevented by their formation from injuriously affecting the internal tissues.) [That *cystoid cicatrix* not unfrequently follows iridectomy for glaucoma is *pro tanto* a reason for choosing the upward position for the incision, rather than the horizontal, or the lower. Any bulge is then quite covered, and so to say restrained by the upper lid, less exposed to external irritation, and especially to friction by the lid margin, and besides not in view. If the cystoid be on the inner or the outer side of the cornea, or even below, it is liable to be pinched and mechanically fretted by the winking movements of the lid, and if prominent it may become a real annoyance, as well as source of danger. I have always regarded the cystoid cicatrix as indicating a tendency to return of undue tension; and accepting such a tendency as a fact in the particular case, have never been too solicitous to close what seemed a safety-valve; while its existence suggested watchfulness and prudence to both surgeon and patient, so as to avoid all causes calculated to re-awaken the glaucomatous condition.

Where a cystoid cicatrix became abruptly prominent in parts, rather than a mere diffused elevation, I often traversed it on the surface of the sclerotica with a broad needle, severing the conjunctiva from the sclerotica on either hand before withdrawing the instrument by the same small aperture. This usually sufficed to lower it even permanently, without any concomitant inconvenience, the aqueous subsequently leaking from the chamber, seeming thereafter to be more readily absorbed or dispersed in the sub-conjunctival areolæ.—W. B.]

XIX.

ON NEEDLE OPERATIONS IN CASES OF DETACHED RETINA

By William Bowman, *F.R.S., in ' The Ophthalmic Hospital Reports,' Vol. IV, pp.* 133–149, *May,* 1864.

A perusal of the very interesting paper of von Graefe, translated by Mr. Rogers in the present part of our Reports, induces me to record the results of my own operations in cases of detached retina [viz., " On Perforation of Detached Retina, &c.," ' Oph. Hosp. Rep.,' Vol. IV, p. 206], though my conclusions on the subject are as yet extremely incomplete.

I have only operated at all in such cases since 1862, and my object has never been to give external vent to fluid, though this has almost always been one immediate effect of my punctures, but rather to open a permanent communication inwards from the sub-retinal space, under the idea of allowing the effused fluid to escape into the vitreous chamber, rather than to spread further between the retina and choroid, thereby further severing their organic connexion. So slight is this connexion, that fluid effused at one part easily gravitates to another more dependent part.

We are at present very ignorant as to the precise pathogenesis of these effusions. I have seen several examples of them as a direct consequence of external injury to healthy organs. They are very prone, however, to occur in myopic eyes where we can understand that the general extension of all the coats in the elongation of the globe would facilitate such a sort of sliding of the retina on the choroid, as might favour a severance of their slight union ; or that state of the coats, whatever it may be called, which attends the elongation of the globe, may itself dispose to sub-retinal dropsy. Hypothetically, we may imagine the effusion to occur from inflammatory causes, the fluid being in that case a product thrown between the membranes and forcibly tearing them asunder. It might be secreted over a larger or smaller area, and spread more or less widely from its source, so as to do secondary damage according to its amount or the rapidity of its formation. On the other hand, any atrophy or diminution of the bulk of the vitreous may be conceived to produce the same effect by lessening support on the vitreous surface of the retina. Perhaps difference in the degree of intervention of such causes as these may explain the important differences we witness in the course of the phenomena in question. I have no doubt whatever that effusions of blood into the choroido-retinal space, and thence into the vitreous, sometimes occur in consequence of a previous diminution of the eye-tension by a lessening of the bulk of the vitreous; and I have so often found the eye inclined to softness in cases of detached retina, that it seems to me fairly supposable, that serous effusions also are often due to this cause.

On the other hand, in one very interesting case, which I shall relate, a rather exceptional increase of tension to the first degree, T1, occurred in connexion with sub-retinal effusion. I can only recall three or four cases in which any tendency to increased tension has been met with in my own experience.

When I first ventured to operate in cases of detached retina, I only entertained faint hopes of arresting the spread of the disorganization, by opening a permanent way of escape for the fluid into the vitreous cavity; and when a positive and sometimes a considerable amelioration of sight took place even in those parts of the field corresponding unequivocally to detached portions of the retina, I was not less surprised than delighted.

An examination of the fundus of the eye has often corroborated the fact, already observed by von Graefe and others, that a part of the retina actually raised from the choroid, by fluid, may retain a certain degree of perceptive power. Where the vision has much improved in consequence of an operation, I have found satisfactory changes in the ophthalmoscopic appearances of the improved part; not indeed a return to a perfectly normal state, for the retina remains as if swollen by water or seen in a watery medium, but a replacement of the elevated portion into apparent apposition to the choroid. Retina raised, but not floating or thrown into visible folds, has often a very peculiar appearance under the ophthalmoscope. For this purpose I use the coronal flame of an Argand gas-burner, which is seen as a milky-white circle wherever it falls on retina so affected. I am not certain on what precise conditions this appearance depends. The retina may seem œdematous and swollen without exhibiting it. I think it depends on a certain elevation of the membrane from the choroid, together with a comparatively unaltered state of the retinal tissues, and that where it exists there is a prospect of improvement of function on replacement. This I suppose to be impossible when the detached retina has become opaque.

With regard to the questions of a physiological nature opened by the fact of this retention of perceptive power in portions of retina separated from the choroid, it seems certain from what we know of the layer of rods and bulbs (which we suppose for many good reasons to be the immediate recipient of the luminous impressions)* that these anatomical elements are not at once, or necessarily, broken up by the contact of the fluid, or by their disruption from the choroidal epithelium. For the improvement of sight has been in several instances extremely rapid, almost immediate, after my operations and before any reproduction of these elements could have occurred, even if that were proved possible. It is obvious that this immediate recovery must be chiefly due to the restoration of the retina into its true focal position and to the unravelling of its eclipsing folds; but I am speaking of the share taken by the layer of rods and bulbs, independently of the other layers. That these delicate structural elements are not prone to undergo degenerative changes may be inferred from their being often found little altered in blind glaucomatous eyes, when all the other retinal tissues are more or less spoiled, a fact I ascertained many years ago, when excising such eyes. The fluid effused has been always apparently clear; generally more or less yellowish, or serous; at other times colourless, like water. I have several times collected enough of it to demonstrate to the students at the moment, by heat or nitric acid, that it contained albumen. Sometimes it has become only very slightly turbid under these tests, but when most yellow in colour the albumen has been in sufficient proportion to render the whole opaque. If in any case the fluid be without albumen, it would at all events probably contain saline matters, and would hardly be of the tenuity of the aqueous humor. If mere water, it would of course disintegrate the rods and bulbs as water does out of the body, and this it does not appear to do.

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* *See* Donders "On the Anomalies of Accommodation and Refraction of the Eye," in 'New Sydenham Soc.,' Vol. xxi., Introduct.

The rods and bulbs being thus regarded, as, at least often, not structurally impaired by detachment, we may infer with much certainty that even a slight elevation of the retina from the choroid would alter the normal vertical position which we may regard as so essential to their perfection, as recipients and isolants of the pencils of light making up an image. If thrown irregularly into sloping positions, like corn beaten down by the wind, a single pencil of rays would fall through a portion of many of them, and each element would receive light from many pencils, with corresponding confusion of perception. Moreover, no element would receive its light in that vertical direction for which it is fitted, and additional confusion might arise from disturbance of the natural absorption and reflection by the choroidal epithelium.

These remarks would apply to very slight variations in the inclination of the rods and bulbs, and may even be regarded as not altogether inappropriate to explain in some measure the feebleness of retinal power in high degrees of myopia without detachment, where probably, in addition to the opening out or expansion of the retinal structure due to the yielding of the eye-coats, and which would involve its own proper enfeeblement of sensibility by lessening of the number of retinal elements in a given space, there would probably be also some sloping of their lines of direction.

In all my cases the ophthalmoscope has previously shown the position of the effusion, and of course at the same time indicated the seat for operation.

Atropine has also been used for ophthalmoscopic examination previously, but as the pupil is often already large, it is not always required for this, and it in some measure prevents exact examination of the acuteness of vision immediately after operation. I have not used it for the purposes of the operation, as I have been guided in the directions given to the needles altogether by that of their handles outside the eye, but it is not impossible that attempts to direct their movements by the ophthalmoscope through the pupil might succeed. I know my friend Dr. Bader has done something of this kind with the ingenuity which distinguishes him. Of course, however, such a method would have its own peculiar risks of wounding the lens. It would be almost essential that the direct image should be employed, and the operator must have the most perfect reliance, not only on his own dexterity, but on the self-command of the patient, for it would not then be so easy to use chloroform.

I have operated generally without chloroform, sometimes with it. The patient has been lying or sitting with the head thrown back. I have never used a knife, but only fine lance-pointed needles, such as we use in cataract operations, the puncture made being very small.

The punctures have been always made through that part where the effusion was supposed to lie, and almost always some fluid has escaped at the time under the conjunctiva, sometimes outside it; occasionally when none escaped at the moment, the sub-conjunctival tissue near the orifice was seen to be œdematous shortly afterwards, apparently from an oozing of the same kind; occasionally such an escape continued even for several days, but usually the œdema round the puncture had disappeared the next day.

Although the eye-tension was generally not more, but even rather less than normal, the sub-retinal fluid commonly escaped outwards rather promptly, so as often to raise a small abrupt swelling immediately about the needle. In the course of half-an-hour this has diffused itself over the neighbouring areolar spaces. This readiness of escape under normal or slightly minus eye-tension would, of course, occur when an outlet was provided, just as the aqueous humor would escape under a puncture of the chamber. It occurred with less force when chloroform was used, the muscles of the eye and lids being then quiescent, and compression from that source removed. It illustrates the reaction of the coats of the eye on the eye-contents under normal or even slightly minus conditions of tension. The eye immediately afterwards has always been softened to the degree –T1 or –T2, corresponding to the amount of fluid withdrawn. This minus tension variously continued one, two or three days, apparently according to the time when leakage through the punctures into the sub-conjunctival tissue ceased. The T afterwards usually resumed its previous degree.

The puncturing was not commonly painful, except when it was necessary to hold the eye with forceps to guide the direction of the needle as to avoid the lens. All pain ceased immediately the operation was over.

After the operation the globe, becoming somewhat relaxed by the oozing of the fluid, is apt, for a time, to have "lightning flashes," "momentary coruscations," like "sheet lightning," &c. These occur when the eye moves, and are probably due to the bending of the retina by the traction of the external muscles on the eye-coats.

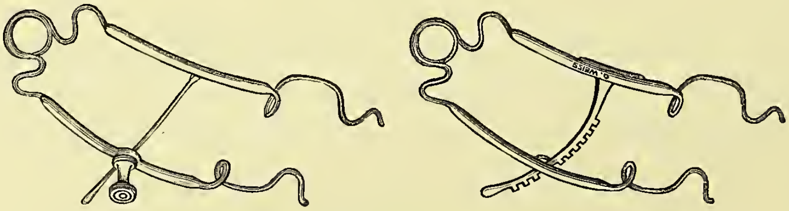
Or they may be due only to the alterations going on in the position of the retina as the fluid changes its place. They are to be distinguished, I think, from another sort of photopsia, which belongs to changes in the tissues of the retina itself under the same causes which produce the effusion. The retina is sometimes sparingly speckled with ecchymoses, independently of the operation, and such photopsias not unfrequently attend the affection at the first.

The region of the eye actually punctured has varied, but it has usually been from a quarter to half an inch behind the cornea and between the recti tendons. The effusion was generally seen to be spread over such an area that a choice was left, and I preferred passing between rather than through the tendons of the recti. The needle was always thrust vertically in towards the centre of the globe, being thus turned from the situation of the lens. In no case was the lens wounded, nor do I regard it as in any danger when the operator has presence of mind, and keeps its situation in mental view while the needle is in use, and especially if the eye rolls. I avoid the use of forceps, if possible, and do not find them very necessary.

When an opening is made in the retina, of course the retinal tissues in that part are sacrificed. This is a small matter if it be the means of saving sight in other parts, or averting total blindness. But if, in a part of the field, there is already before the operation, total absence of perception of light, I select the corresponding part of the retina for operation, so as to entail no unnecessary sacrifice. But in truth, the sacrifice of an eccentric portion of the retina, especially if near the front, is of trivial importance in any such case, and the gain of extent of field has often, even generally in recent cases, greatly exceeded the loss. In my first operations I conceived it desirable to use the fine needle only as a puncturer, introducing it at one or more points in succession as seemed best. Sometimes no serum escaped outwardly at the first puncture, and there was a doubt whether the right site had been hit upon. I then, on a second puncture near the first, got evidence of effusion. I thought it likely, in the case of a limpid effusion on so small a scale, when the difference of pressure on the two sides of the retina was so trivial and when all we wanted was to establish a permanent orifice of communication, however small, that one or more needle punctures might suffice. But von Graefe's view of the desirableness of a freer orifice may be correct. Experience must determine this. Another reason for employing a needle instead of a knife was as far as possible to avoid the division of any artery or vein of the choroid, for it seemed probable that in a case where the eye was at first slack, or became so on the puncture, any blood from such a wounded vessel, even though very small in quantity, would be likely to flow inwards as easily as outwards, and so complicate the operation unnecessarily. Von Graefe does not notice the occurrence of any bleeding in the use of his cutting instrument, which of course made a small incision rather than a puncture, so that probably this apprehension on my part was groundless. Nevertheless, it still seems to me, that if the object can be attained by needles they are to be preferred to a cutting instrument. To avoid sub-conjunctival ecchymosis, the needles, on being inserted, should be introduced between any visible vessels.

Having observed a recurrence of the symptoms in a case in which needle punctures had already been made with only temporary benefit, and having understood that von Graefe had employed the knife with the intention of cutting a free opening in the retina, I considered whether two needles might not be employed for dilaceration of the detached retina, on somewhat the same principle as in the case of opaque capsule in the pupil, that, namely, of introducing each separately through it, and of then tearing it open by suitable movements of one needle on the other, by crossing or separating their points. I have endeavoured to carry out this idea on several occasions and in several ways, keeping in view in each instance the probable distance of the summit of the detachment from the choroid; in other words the extent of projection of the retina towards the centre of the vitreous, as observed by the ophthalmoscope.

The diagrams will explain my meaning. The continued lines show the first direction of the needle and the dotted lines the second direction, when it has been turned on its point of passage through the sclerotic. The spherical curve shows a section of the sclerotic and choroid, the undulated one a section of the detached retina. The sections are imagined to run through the equator and the needles to work in that plane. Of course this would vary in actual practice, and usually the needles would be introduced in some part of the anterior hemisphere, and their points would then be directed in the first instance rather backwards towards some part of the plane of the equator, so as to keep away from the lens region. In introducing two needles, and even in simple punctures, it is well to use either Dr. Bader's or my own stop wire speculum, with screw or rack, as in the figures.* This effectually prevents the pressure of the globe by the lids. I sometimes fix the globe with the forceps on introducing the first needle, which afterwards becomes a sufficient holder in itself. The surgeon must be careful, if the globe rolls, to keep the needles in their true position as regards the lens.



STOP WIRE SPECULUM, WITH SCREW, AND WITH RACK.

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[*] I give a figure of this latter, as it may not be generally known. The screw for fixing is now replaced by a rack.

In fig. 1 a single needle is represented, vertically inserted. If two needles are used simply in the way of puncturing, it may be well to introduce the second before the first is withdrawn, before the globe slackens by any escape of fluid from the first puncture.

In fig. 2 two needles are in use, introduced at some distance apart, and so directed as to pierce the retina, as near as may be, at the same point.

In fig. 3 two separate needles, made to fit against each other by their handles, are shown in two positions. They are introduced as a single instrument, and their handles are then separated. Each turns on its point of penetration, and of course their points diverge in an opposite sense to the handles.

FIG. 1.

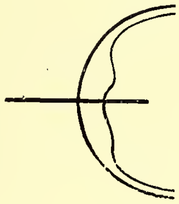
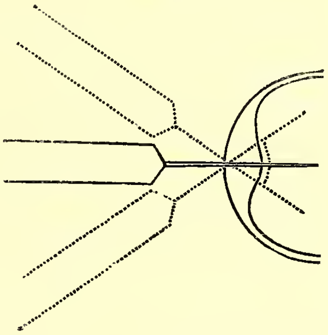


FIG. 3.



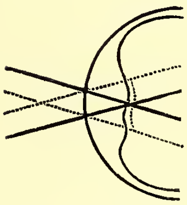


FIG. 2.

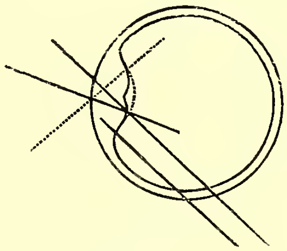


FIG. 4.

By thus running one or two fine needles as far as the centre of the globe, or further than the centre, through the region where the detachment lies, we may be quite sure, I conceive, of penetrating the retina. It can hardly recede before the point of the needle, so as quite to elude it. The needles enter it from without inwards. But it is possible, delicately hung as the retina is in its false position, that as the needles are assuming their second position, it may run down on their stems, or some fold in it may be opened out, and thus it may escape laceration. This may happen if it be much folded, or if the needles happen to have penetrated near each other, but with a fold between them, for of course, the precise details must be accidental; we cannot under any circumstance hope to have them exactly in view. This may, perhaps, be particularly liable to happen if the retina be much detached, with ample folds, but not very much thrown inwards. It would be less likely to occur when the separation was not considerable, though in proportion to its nearness to the choroid would the opening effected by the movements of the needles be less. The further apart are the points of entry, the more chance there would be of making a wide opening.

This apprehension lest the retina might slide down the stem of the needles towards the point of entry, and thus elude rupture, has led me to try another method (fig. 4), that of introducing one long needle at some distance from the part of the retina to be lacerated, and pushing it either near to or through the sclerotica in the region of the detachment, thus piercing the retina there from within outwards, so as to secure the penetration of the detached portion, and give a fixed point for the second needle to work from. The second needle is then introduced in the region of the detachment from without inwards, its point being directed towards the presumed situation at which the first needle has pierced the retina, and this second needle is then moved upon the first. If the point of the first needle remains within the eye, not transfixing it, it should be held stationary, lest it should scratch the choroid.

What I have now said represents my present views, which I offer with diffidence, as only hints to be further worked out by experience.

We may suppose that laceration by needles may have this advantage over division by the knife, that it could hardly wound any retinal vessels; the retina would tear where it offered least resistance, *i.e.*, in its vascular areolæ. Near the front, however, where these operations are usually practised, the vessels are the smallest. It is possible in the case of detachments in the posterior hemisphere, which it might be desirable to operate on, that cutting from within outwards, and perhaps with the direct aid of the ophthalmoscope, may hereafter be found the preferable method. It is then less easy to manipulate the needles inserted in the region of the detachment owing to its deeper situation. Yet under chloroform, and with the globe rotated by forceps, the hinder part is not so inaccessible.

In several cases, where the immediate improvement in vision made it pretty certain that the retina had been opened by the needles, I failed, like von Graefe, to discover the opening by the ophthalmoscope. In three instances it has been plainly visible of an angular shape, and the retina near it has exhibited small folds of an unusual appearance, as though the membrane had retained in some degree the wrinklings impressed upon it by the needles at the moment when the laceration was effected.

As to the results of my own cases, which include examples of the disease at almost all stages of its progress, some early and partial, others advanced and widely extended, I am unwilling by any general deductions from so small a range of facts to anticipate the future. So far as they go, however, they seem to justify the following remarks.

Like VON GRAEFE, I can say I have never in any case seen serious harm done, such as caused me to regret the operation, either in the way of vision, or of inflammatory trouble.

In some cases very decided improvement of sight has occurred, both as to the extent of the field and the acuteness of perception, sometimes in a few minutes or hours, at others within a few days.

In some cases the improvement has been very slight—a little enlargement of the area of the field, better perception of objects under the same degree of illumination as before. In others, again, there has been no improvement whatever ; in others still, the loss of sight has ultimately proved as complete as if no operation at all had been performed.

As to permanence of results, the cases show so far something that is satisfactory. The improvement has been maintained in some for two years, and up to the time when they were last seen. In others there have been relapses, for which second or third operations have been done with variable effect.

In estimating these facts, the variable course of the disease, where no operation is performed, must be borne in mind. Nothing but a more extended study and trial can settle the degree of advantage to which the operation can fairly lay claim. Meanwhile it must be remembered that the disease has hitherto been generally regarded as desperate, leading in almost all instances sooner or later to complete blindness, and that even if some may think other than operative treatment to have any efficacy in arresting the extension of the mischief, such treatment would not be precluded by the operation, while it could hardly be deemed by any to offer the slightest hope of replacing the detachment. In fact, either the disease has usually a local origin in a previous condition of the organ, myopia, &c.; or it occurs without any apparent cause in persons without definite general disease; or it comes on in connexion with long weeping, or depressing causes, which do not admit of immediate removal, and the removal of which, were it feasible, would hardly restore or improve the condition of the retina.

Hence in the present imperfect state of our knowledge, I am favourable to the trial of some such mode of operation as that I have suggested. It has proved harmless in all cases, beneficial in several. And I am encouraged to go further than VON GRAEFE, and to advise that it should at present be performed whenever detachment exists, inclining to spread, and when there remains some vision to be saved. Particularly I should perform it when the retina presents the bluish-white, milky aspect where the image of the light falls upon it, which I have mentioned above at page 324, because then there is less damage already done, and more chance of replacement and recovery of functions. If it is to be attempted at all it seems reasonable to perform it *early*, that the chance it affords of putting a limit to the spread of the effusion may be given when its value will be greatest. It also seems reasonable to perform it on an eye whose fellow is still unaffected, not only on the principle that we ought to try to save all the sight we can—not knowing how soon what is lost may come to be regretted—but also because detached retina so often occurs in both eyes that we may even expect the arrival of such regrets with some degree of probability. I say nothing at present as to the disease in one eye possibly influencing the other by sympathy. That question is a very difficult one to handle, and is full of ambiguities. But that it admits of being fairly raised may add an argument in favour of interference.

Of course whether operation be had recourse to or not, no prudent surgeon would neglect whatever may seem rational in the way of other treatment and management, for an operation need in no degree interfere with this.

Von Graefe has noticed the vitreous humor to become clouded after some of his operations, and I have observed the same thing—not by any means constantly, or when the evidence of an opening having been effected in the retina proved the most satisfactory. He supposes it, as I understand him, to arise from the admixture with the vitreous of the clouded sub-retinal effusion, and it may be so, though the effusion which has escaped at my punctures has always seemed transparent. But some turbidity might result from the admixture of even a transparent effusion with the vitreous, by the subsequent precipitation of particles, and this, perhaps, is his meaning. Such cloudiness of the vitreous, however, is apt to attend sub-retinal effusions, even when there does not appear to be any rupture of the retina, any orifice of communication. It may naturally result from an extension to the hyaloid surface of the ciliary body, or to the retina itself, of the same morbid process which has furnished the sub-retinal fluid. When it occurs after an operation, it may be explained by the vascular reaction following the operation, trivial though it be, as easily perhaps as by the admixture of the fluids; so that I should be inclined, where the repetition of a puncture might seem desirable, to defer it until all irritation from the previous one had entirely subsided. In particular, where the eye continues for a few days a little softened by the oozing of fluid outwards, and it remains slightly tender and its sclerotic vessels a little congested, I should postpone any second interference until this had quite ceased; for it seems obviously imprudent to run any avoidable risk of exciting an eye already so seriously affected. I may say, indeed, incidentally, that I had expected, *à priori*, that such eyes would be prone to vascular reaction on the slightest provocation, and on this account also I use the finest needles. But, on the contrary, experience proves that they are singularly tolerant of such small punctures or wounds as have been made.

In a few instances vision has seemed so far deteriorated by the operation, as that its acuteness has been lessened; the patient has not been able to read the same type as before. But I think in no such case has this proved permanent; either a subsequent improvement has taken place, at least for a time, or where the acuteness in the direct line has remained somewhat lessened, the field has widened, and there have been evidences in the greater uniformity of sensibility under varying intensity of light, and in the patient's own impressions as to the usefulness of his sight, as well as in the ophthalmoscopic observation of replacement, that the retinal condition has improved, or at least not become worse. A more hazy state of the vitreous humor has then seemed to account for this; an explanation borne out by subsequent amelioration accompanying a return towards a clearer state of this humor.

On the whole, I may remark with regard to this interesting and important subject, that nothing should be undertaken in it except with the greatest caution, and after the most careful and exact diagnosis possible; nor until the severity of the disease, and its probable eventual issue in blindness, if left to itself, the incompleteness of our present experience, and the great uncertainty whether any operative interference whatever will, in the individual case, even at all arrest further decay of sight, have been explained to the patient or his friends. We shall be justified, I think, by the facts already observed, in explaining, where suitable, the object intended by an operation; that it is slight, that it has not been observed to be followed by any dangerous complications, and that in some instances, it has very certainly improved vision, even in a somewhat lasting degree. No doubt every thoughtful practitioner will be influenced in his prognosis by such considerations as the following:—Whether the detachment is already large, or the retina already exhibits a manifest tendency to further detachment; whether the vitreous is already cloudy; whether the assumed local or general predisposing causes of sub-retinal effusion are strongly marked; or whether the patient has for some considerable period been in a stationary condition as regards sight. He must beware, in justice to himself and out of regard to his usefulness to others, of committing himself to any hopeful prognosis; yet I know of no reason why he should not follow in this instance, as in all others, the golden rule; or shrink from the responsibility resting on him, to do for his patients, should they so desire it, what, with the knowledge he possesses of their malady, he would be disposed to ask a skilful friend, in like circumstances, to do for himself.

Since the above was in type, I have seen a trocar used by Dr. Wecker, of Paris, for puncturing the retina, and after withdrawing the fluid from the sub-retinal space, for tearing open the retina where it traverses it. It is introduced from the opposite side of the eye.

A trocar, however, seems a disadvantageous form of instrument for penetrating the coats of the eye. As the sclerotic resists its passage it compresses the globe before entering and then often enters with a jerk, and the eye being then apt to roll, it may take a wrong direction. It also seems better to tear open the retina by two instruments of the finest size, if they can effect the laceration, as I believe they can. It must often be doubtful, too, how far an instrument, inserted from the opposite side, should be thrust in order to reach the detached retina; and some vitreous humor instead of sub-retinal fluid, might be drawn off through it if it stopped short of the retina, which would be a disadvantage. I have only twice seen a little vitreous humor escaping under the conjunctiva in any of my operations, and then it was very thin, and must have come across the sub-retinal space. In such cases, the sub-conjunctival swelling is firmer and lasts longer than when it is caused by mere serosity. Moreover, it is yet very doubtful whether the withdrawal of effused fluid from the eye is attended with any profit. I am not prepared to deny that it may be; but to withdraw fluid has not been the object of my operations, and von Graefe seems even to wish to avoid it. However, it has been almost always an incidental effect of the method of procedure which I have adopted. As for the laceration of the retina, the trocar passed at one point through the retina, and then turned on its point of transit through the sclerotica, might apparently fail to tear the membrane, and might even perhaps drag it more from off the choroid. Hence I should be more disposed to use the needles as above.

XX.

ON EXTRACTION OF CATARACT BY A TRACTION INSTRUMENT, WITH IRIDECTOMY; WITH REMARKS ON CAPSULAR OBSTRUCTIONS AND THEIR TREATMENT.

By William Bowman, *F.R.S., as printed in ' The Ophthalmic Hospital Reports,'* 1865, *Vol. IV, pp.* 332–368.

Preliminary Considerations.

Of late years a general preference has been accorded to the operation of *extraction* over that of *depression* in cases of hard cataract, and also over those other methods of *discission* and *solution* in cataracts, which by the more or less soft nature chiefly of their surface, but occasionally of their nucleus also, may be supposed capable of dispersion by those means.

By *extraction* has been meant the making a curved marginal section, following nearly half the circumference of the cornea, large enough to allow the lens to slip through the pupil on the capsule being opened, and on slight compression of the globe.

When this operation has been executed according to its ideal, and when all the dangers attending the healing process have been happily surmounted, nothing can rival its excellence. Its performance almost painless, even elegant to witness; a recovery rapid and free from suffering; the preservation of a clear, moveable, central pupil; and the perfect restoration of the lost faculty of sight, may well justify the commendation so often bestowed on this masterpiece of the surgeon's skill. And no trace remains of the considerable wound through which a bulky lens has been withdrawn: *ars est celare artem;*—we seem unable to wish for a further step towards perfection.

There is, however, another side to the picture. It is but too true that these highest results cannot be reckoned on with anything like certainty in any case, and they are only actually attained by good fortune, added to skill, where most of the attendant circumstances happen to be of the most favourable order. In a great number of other instances imperfections of one sort or another occur, either in the operation itself, or in the state of the eye afterwards, which diminish the excellence of the result; and many of these are misadventures and mischances which cannot be said to be under the control of even the greatest vigilance and care. And although the average advantages obtained far surpass those of the other methods of operating just referred to, yet distressing and tedious convalescences, and too often in the end the non-recovery of useful sight, form a sequel disheartening alike to the patient and the surgeon. This may be alleged particularly with respect to that far most numerous class, whose position in life precludes them from the full enjoyment of those aids and appliances which a protracted convalescence must require, and to whom the loss of sight is even a greater calamity than to the wealthy, since they have fewer solaces, and more dependent on them for the necessaries of life. Every experienced surgeon is aware how many eyes are eventually lost, which leave the hospital with a fair amount of sight within a month after the operation of flap-extraction. Among the rich, no doubt, a higher average of success is reached.

Moreover, since the general and happy introduction of anæsthetics, it is a serious drawback from any operation that it does not admit of their safe and satisfactory employment, and to this objection flap-extraction is exposed; for the wound is so large that the interior parts of the globe—the iris, the vitreous humor, even the retina and choroid (as I have seen)—are liable to be forced out through the flap gaping under the distension, and perhaps the hæmorrhage, induced by those straining efforts to vomit, which now and then, in spite of all precautions, follow the exhibition of chloroform. Hence if this is to be administered, and extraction of hard cataract to be undertaken, some other method of extraction than that by the large flap must be employed.

It was this unsuitableness of flap-extraction for chloroform, joined with much experience of the anxiety and risks attending its after-treatment, that led me to regard with favour the proposal, emanating from Berlin about five years ago, to extract certain cataracts through a smaller opening, by excising the iris opposite the wound, and making use of a spoon for the withdrawal of the lens. Von Graefe had been the first to practise iridectomy as a step in the process of extraction of cataract in certain cases, and the spoons contrived by his assistant Schuft (now Waldau) were those employed in the first instance at Moorfields.

My first operation there with these spoons was on July 10th, 1860. Earlier than this, indeed, viz., in 1858, I had made use of a true spoon to embrace and draw out the lens, but this had been in exceptional cases of lenses dislocated into the anterior chamber; also twice in the case of lenses congenitally loosened from their attachments, and hanging into the vitreous humor, and where it was an obvious expedient to seize them in such a manner. I had in the first instance, in dealing with a lens in the anterior chamber, extemporaneously used a small scoop that happened to be in my surgical case, and had afterwards had a special scoop constructed. I may also observe that another true traction instrument, and an old one, is the rectangular sharp hook, long in use at Moorfields, for "fishing out" the lens when it has chanced to fall back into the vitreous humor in ordinary flap-extraction.

It is evident, however, that in all these earlier examples an *iridectomy* had formed no essential part of the proceeding. So far as I am aware, we owe to von Graefe the first systematic combination of iridectomy, with the use of a traction instrument, in extracting cataracts of a certain solidity through an opening, small in comparison with the old flap. In flap-extraction the large wound opens so readily to give exit to the lens, that this often bursts forth at the moment when the incision is being completed; and usually, unless the pupil proves rigid, very slight external pressure on the eye suffices to expel it. But with the smaller incision no amount of external compression can force out the lens; the iris and vitreous humor may escape, but the entire lens cannot do so. Hence it is a necessity, if the incision is to be of limited extent, to help out the lens on another principle, that, viz., of introducing a *traction instrument* of some description within the eye, to take hold of the lens and draw it out, or at least to add this principle of traction to that of pressure applied to the exterior of the globe.

It would appear that unless the incision is to be made into the posterior chamber, which on many accounts is inadmissible, such an instrument, however contrived, cannot be used with advantage without a previous removal of so much of the iris as lies across the track of the instrument. For otherwise either only the central pupillary area is available for the traction instrument to work in, and this cannot, with safety to the iris, get thence into its requisite position behind the nucleus, so as to take hold of it, or else the instrument must pierce the marginal part of the iris, corresponding to the external incision, entering the lens out of sight of the operator, and almost unavoidably bruising the overlying iris, or dragging it out with the lens, so as to oblige its excision, if iritis is to be averted.

It might seem at first sight a bold thing to make the removal of a portion of the iris a condition of cataract extraction, thereby permanently altering and enlarging the pupil, when the old flap-extraction admits of so easy a removal of the lens through the natural pupil, leaving the iris and pupil in their integrity; and it is not surprising that this should have seemed to some minds a fatal objection from the outset to the new method.

But it had already become abundantly obvious to those who had practised iridectomy on a large scale, especially for glaucoma, that this enlargement of the pupil, especially if made upwards, need detract in no important degree from subsequent acuteness of vision; and, as a matter of fact, it is certain that such altered pupils admit of the smallest test-types being read.

Moreover, not only does this mode of operating admit of the administration of chloroform, but it is much more efficiently executed under chloroform, and if any sickness follow, few evils are entailed. In addition, the inestimable advantage is gained of absolute immunity from all the complicated annoyances and dangers of prolapse of the iris; so that the after-treatment becomes comparatively simple, and the recovery generally rapid and satisfactory. I speak of cases in which all the parts of the operation are well and satisfactorily performed. The operation is more complex than flap-extraction, it involves more manipulations with instruments within the eye, and demands a more perfect mastery of the exact anatomy of the structures dealt with, and perhaps more delicacy of hand to make no slip, especially with cataracts of a certain consistence. But the use of chloroform makes this perfect manipulation more easy, and no one should undertake any of these critical operations without a perfect familiarity with the shape, relative size, position, and consistence of the textures concerned. In offering a judgment on the respective advantages of various methods, it is fair to speak of each as if it were ably executed by a competent operator, according to its ideal. I have repeatedly remarked to my class during the last three years that this traction-method is in itself somewhat more difficult of perfect execution than flap-extraction, and that it has its own risks and liabilities, especially those attending the use of the tractor, but that when its steps have been all well accomplished, which they ought to be under chloroform, the patient has a much better prospect of passing safely and speedily through the healing process, and of recovering his sight, than if he had left the operating-table with a perfect iris, but with a large flap-wound and its attendant risks.

But it must not be supposed that I am for altogether abandoning the old operation. There will be occasions when a number of circumstances favourable to it combine to give it the preference over every other; those, viz., in which we can with the greatest confidence reckon on a perfect execution of the operative steps, upon complete quietude of the eye afterwards, and an uninterrupted healing process.

If chloroform is declined, and these favourable circumstances concur, flap-extraction is indicated as the less painful, the shorter, and the simpler operation. In some instances chloroform may be regarded as in itself objectionable, as in persons having a great tendency to faintness, or to stomach derangement, in whom much distress, protracted vomiting, or weakness might be apprehended. Such cases I consider to be very rare. Such results have, however, two or three times unexpectedly occurred, and caused me to regret that chloroform had been given. Often when chloroform is at first refused the scruples of patients may be overcome, and when the balance of advantage seems to be on the side of the method by traction, I urge its administration, because the steps of that operation can be so much more perfectly performed under its influence. If it is still declined, however, the traction method is by no means therefore inadmissible, only then the eye has to be more carefully fixed, the patient should be under better self-control, and the operator more entirely master of his own movements. Nothing but large personal experience can determine the best course on doubtful occasions. If chloroform on the contrary is desired, flap-extraction becomes inadmissible, as involving serious and unnecessary risks from sickness.

The circumstances referred to as favourable to flap-extraction are such as the following:—

1. *As to the operation itself.*—A good anterior chamber, a dilatable pupil, a cataract which, by its visible characters and by its history, promises an escape of the whole lens *en masse* from its capsule (this, however, cannot always be predicted), the eye neither too prominent nor deep set, the lids not irritable, the patient calm, and able to control his movements, the eye healthy in other respects, not inclining to hardness, or its vessels disposed to grow turgid, so as to project the iris or cause escape of the vitreous when the section is made or the lens expelled.

2. *As to the after-process.*—The having the means of keeping the patient perfectly quiet after operation, with an experienced nurse, and the requisite appliances of all kinds, mechanical and moral. Tractability of the patient, a quiet nervous system, absence of inflammatory or other tendency likely to interfere with the healing process:—this last head might be pursued into much detail.

On the other hand, where some of these favourable circumstances are wanting, as must very often happen, or what comes very nearly to the same thing, where the operator can have no confidence in the existence of those which are doubtful, prudence may well incline him to the traction method, since it must be his plain duty to endeavour to secure by the most effectual means the main object in view, viz., the recovery of the power of seeing usefully, including that of reading all ordinary type, even though the sacrifice be involved of what under the highest good fortune might have proved one further step in beauty and faultlessness of result—a central and movable pupil.

The surgeon, then, will be strongly impelled to the traction operation in cases where a rapid recovery, or escape from tedious treatment, especially of that for prolapse, is more than usually desirable, *e.g.*, generally among the poor, in old, very weak, or nervous persons, in those of an irritable habit, in inflammatory subjects. Also in cases where the after-care of an experienced nurse cannot be procured. Also in unmanageable patients, as lunatics, or the perverse, obstinate, or self-willed. I performed this operation under chloroform, on both eyes of an eccentric, half-witted old man, who was found the same evening, to the terror of the nurse, sitting with his feet on the fender, staring with both his eyes open into the fire. I never saw a more perfect or a more rapid recovery. Also when the patient must be left after the operation in the hands of persons not accustomed to such a charge, and who would willingly have as little responsibility thrown upon them as possible. Also in cases presenting complications—a large and very important class, including diabetes, and many other morbid conditions of distant organs, or the system. Also, among ocular complications, in myopia, if considerable, with its changes of the fundus, and in old choroidal and retinal lesions. I place apart, as not coming within the scope of this paper, but demanding separate treatment, numerous cases of iritic and irido-choroidal disease passing into the glaucomatous forms, which have so often to be dealt with in connexion with cataract. In all these, however, iridectomy, either previously or at the moment, forms an essential part of the treatment required for the cataract, and the opaque lens should be removed by traction.

Conversely to what was just now said as to conditions of the eye itself favourable to flap-extraction, the following make the traction principle the more suitable: a deeply set, or a very prominent eye, a very irritable eye, a very shallow chamber, a small rigid pupil, and of course an adherent one.

As to states of the lens itself, especially as regards stage of the cataract and consistence, whatever makes the loosening of the lens from its capsule difficult is so far against both modes of operating, but does not exclude either.

Details of the Traction Method.

In now proceeding to speak of the operation itself, I propose, even at the risk of seeming tedious, to enter into the minuter details, as these seem to me to be all of them important in their degree, and likely to have much influence on the opinion that may be formed of the operation by those who may be performing it for the first time, or with hitherto inadequate experience.

The operation has been rejected by some, apparently because it has been performed without due regard to the niceties which belong to it, and which, speaking generally, are necessary to its success over other methods. To communicate the details of the experience I have acquired, therefore seems to me to be due to the operation itself, and to those who may be disposed to make trial of it. In recommending the traction method, it is as practised with the precautions described.

Let the object be kept in view of getting away the whole lens through a small opening, with the necessary sacrifice of only that portion of the iris which lies in the track of the instrument. This has to be accomplished effectually without damage to the vitreous humor (the suspensory ligament and the posterior capsule, therefore, have to be left entire), and without any mechanical injury whatever to that part of the iris which remains, and which, therefore, is little liable to traumatic inflammation. The eye has to be left by the operator without its lens, and with an altered pupil, but otherwise uninjured, except by the usually harmless marginal corneal incision. All the details of the operation go to secure this result.

Chloroform should generally be given, and if given should usually be given fully, so that the eye remains quiescent throughout the operation. When it seems desirable to administer as small a dose as possible, I often make the preliminary incision and the iridectomy under its partial influence, reserving its full effect for the most critical period—the introduction of the instruments which have to deal with the lens—a period lasting perhaps only a few seconds.

Operation.

If the pupil is small and rigid, atropine may as well be applied previously, otherwise not. The patient lies on his back with the face upwards, and his feet towards a window. The operator stands or sits beyond his head, which is slightly inclined towards the light, uses the wire stop-speculum for the lids, and fixes the eye with forceps, which take hold of the tendon of the lower rectus precisely in the middle, close to its insertion. He then rolls the eye downwards, with care not at first either to compress or to pull upon (I do not mean to rotate) the globe, for to pull upon it is really to compress it. The holding forceps should be slightly toothed, so as to seize the tendon readily. To seize the tendon, or at least the sub-conjunctival tissue, and not the conjunctiva only, is to obtain a perfect hold on the globe; the conjunctiva alone may tear away, or by sliding on the globe may render the forceps no longer the guide they should be to the point of incision, by being precisely opposite to it; for the eye, in being held downwards, is usually somewhat rotated on its antero-posterior axis. During the act of iridectomy, unless the eye is quiet and lies well, I generally give the fixing forceps to a skilled assistant, taking them again into my own left hand while the traction instrument is being used with the right hand.

As to the incision. Position.—The iridectomy should be usually made directly upwards, both because it will not be visible afterwards, and because, being covered by the lid, it will the less detract from the optical perfection of the organ. The lower or central part of the resulting pupil will be that used in vision. It is perhaps a little less easy to execute the steps of the operation when the upward direction is chosen, but if the eye is rendered passive by chloroform, and the globe rotated sufficiently downwards without being compressed, no real difficulty need occur.

Shape.—The lancet-shaped knife (which should be slightly bent on the flat, and of which the cutting edges should meet at an angle of about 50° or 55°) should enter the extreme margin of the anterior chamber, and be pushed on with its flat parallel to the iris, until its point reaches the opposite rim. It is then gradually withdrawn, and as the aqueous flows slowly away it may be made to enlarge the wound at one or both angles, if requisite. In withdrawing it, the point may incline to one or other side of the chamber, so that the lens should not incur risk from the point traversing the pupillary space, in case of any sudden, unexpected movement of the eye. This is a good precaution in all cases of iridectomy, but, of course, all the more important when the lens is transparent, and not to be involved in the operation.

The wound thus made is curvilinear, and follows the rim of the chamber, passing through the corneo-sclerotic junction. It cuts this tissue not vertically, but in a plane about parallel to the iris, and its middle part and ends are in the same plane. As it need hardly in any case occupy more than a fourth of the circumference of the cornea, the effect is that if the globe is compressed by the lids, or if the vessels of the eye become turgid under the chloroform or afterwards, so as to occasion internal distension, the wound hardly gapes, it rather closes; whereas if the eye is slackened, the hinder or sclerotic lip is easily pushed back, and the anterior or corneal lip forwards, by the traction instrument inserted, so as to allow blood to escape from the chamber, and to give ample room for even a bulky lens to emerge under the guidance of the tractor. The incision thus made is near to the equator of the lens, which is thus more easily dealt with by the tractor, and fragments of it do not easily elude the instrument by slipping up behind the posterior lip of the incision.

The incision is faulty in direction if its ends leave the line of the corneo-sclerotic junction and curve into the cornea. It then describes an arc of a smaller circle. The flap formed is less roomy for the exit of the lens, and yet it is more disposed to gape and lie unevenly; moreover, the iris is less perfectly excised at the angles. It is more exposed to be bruised there, and lateral fragments of the lens to be entangled and left in, occasioning irritation afterwards. This faulty form of flap is familiar to operators by the old method, when the incision has not been a happy one. The *direction* of penetration should be the same at all parts of the incision, viz., from first to last in a plane nearly parallel to that of the iris, and just in front of it.

Extent.—A judicious operator will vary the extent of his incision by his estimate of the probable size of the firm cataractous substance which has to pass through it, always taking care that the opening is *large enough.* It is far better to have it too large than too small, and it is particularly desirable that it should be ample in such old cataracts as are supposed to have their margin easily detachable in small segments. For one of the disadvantages of this traction method is the liability to have the sides of the lens separated and left behind near the angles of the wound, giving rise to subsequent irritation; a too narrow path of exit disposes to this, and in such cases an incision of nearly one-third of the corneal circumference, especially when the cornea is small, is desirable. In old cataracts that have had formerly a softened surface, the remains of this seem often to accumulate at the equator, where they undergo fatty degeneration, and readily break off in chippy fragments.

Where the whole lens is firm and of nearly equal consistence up to the margin, as in some old cataracts, and also in those of slow progress in middle-aged persons, which have commenced with striæ near the surface, the opening should be proportioned to the size of the cataract, so as to give it room enough to emerge; but the largest sized opening is nevertheless not required, as the margin of the lens does not break off, and the whole admits of being drawn out entire and with safety through an opening comparatively small.

The cases for which the smallest incision will suffice are those where we may be pretty sure that the nucleus, if hard, is small, and the surface of the cataract diffluent, or pulpy or semi-fluid. The opening is then made to suit the size of the nucleus, it being certain that the surface matter, though abundant, will be effectually got out easily through the same channel. But it is important here to have regard to the exact consistence of this surface matter. For though very soft it may not be so loose and diffluent as to flow easily from behind the iris into the pupillary space, and so out at the wound; but on the contrary, it may be glutinous, adhesive, and semi-transparent, and therefore much more apt to remain within the chamber if the harder nucleus has to emerge through a narrow wound, through which it can only come stripped of its surface matter; whereas if the opening be ampler, the surface matter or the greater part of it may be made to emerge with the nucleus without being much detached from it, if care be taken in using the scoop.

When it is wished to make an opening of the largest size, this may be best effected by enlarging the wound at one or both angles on withdrawing the knife, and to do so has the additional advantage of making the inner aspect of the section as wide as or wider than the outer, which a lance-shaped instrument, if allowed to cut only in entering, could not accomplish; and this shape of the wound, irrespective of its mere size, is probably favourable to the escape of lens-fragments. Even if the knife has to be re-introduced, I prefer it to the scissors, which are apt to cut too much within the corneal margin, and not in the same plane as the knife has done; moreover, they cannot be made to cut conveniently at either angle indifferently, as the knife can do, without the operator changing his own position; and I also think them more likely to bruise the iris.

As to the Iridectomy.

In dealing with the iris in this operation, the great object is to secure the eye against inflammation of that part of the iris which remains. If the nucleus of the lens is small and the surface of the cataract diffluent, so that the extraction by a small opening is easy, and the risk but slight of small glutinous or hard fragments remaining behind, the iridectomy need not be large. In some such cases I have so managed as that the pupil has remained afterwards nearly circular, the pupillary margin having been rather divided than excised, the iridectomy involving chiefly the upper part of the membrane. No doubt the less excised the better in an optical sense. But a far more essential thing is to secure the eye against inflammation of that part of the iris which remains; no portion of this should be on any account contused or rubbed against either the lens, the cornea, or the instrument. It is much better therefore to excise widely than by removing a smaller piece to hazard the bruising the edges of the remainder during the movements of extraction. It is better to err, if at all, on the side of an ample excision. The margins of the cut part are then also not so liable to entangle fragments so easily, or to become irritated by their presence if retained.

The iris is seized by the small curved forceps, drawn out, and snipped off by scissors. I used to leave its ciliary border, but I now much prefer to excise its whole breadth, as being the safer method. What remains is less on the stretch, yields more, and is less apt to become inflamed; moreover, with care there is then no greater risk of the escape of vitreous. The mode of seizing with the forceps influences the amount excised. If a small excision is desired the blades should open very slightly and seize that part that lies opposite the centre of the corneo-sclerotic incision, and which is midway between the ciliary and pupillary margins, and it should not be drawn out much before the scissors are applied. If a large excision is intended, the blades of the forceps should open more widely, and the iris may be dragged out further, and be thus torn from the ciliary attachment to the required extent before being cut off.

It may be cut off by a single movement, or divided first in the middle and then at each angle of the wound separately. A method, which I think a good one, and generally follow now, is to seize it and tear it a little from its ciliary attachment near the right-hand angle of the incision, and cut it across there on the right of the point held by the forceps; then tear it away as far as the opposite angle of the wound, and cut it across there also. By pulling it out at the angle of the wound before cutting it off, the ciliary separation and the iridectomy may in this way be easily made more wide than the incision itself, which in some cases is advantageous, and is always safe, since the cut margins of the iris recede well away from the track of the instruments dealing with the lens, and cannot lie in the angles of the wound afterwards. I think it likely that when iritis follows this operation it is often an extension of irritation either from the ciliary edge of the iris left remaining at the site of the iridectomy, or from its cut margins bruised by the tractor, or entangled in the angles of the wound.

If blood flows into the chamber so as to disguise the iris and lens, either before or after the iridectomy, I prefer waiting till it ceases to flow, and to remove it, before proceeding with the next step. It should be removed as it flows, and before it coagulates, by inserting the point of the curette, if necessary between the lips of the incision, while the forceps holding the lower rectus tendon, slightly pull or compress the eyeball.

It is not often, indeed, that blood does flow to an extent to require this, but if it do, and is left in, it obscures the view, and thus not only renders the succeeding steps less delicately exact, but makes it less easy to spare the remaining iris from all injury, and to withdraw loose fragments of lens. Hence I insist upon this point of practice.

Opening the Capsule.—The next step is to open the capsule. This is done with one of the ordinary flat-ended prickers used in flap-extraction. I have only to intimate the extent of the opening and the precautions to be taken. The object is so to open the capsule as to destroy or effectually tear through *all* that part which lies in front of the attachment of the suspensory ligament, but to save the suspensory ligament, and all the capsule behind it, as a safeguard to the vitreous humor. Opening the capsule thus freely facilitates the escape of the marginal lens-substance, and also lessens the chance of subsequent so-called capsular opacities in the pupil. Such opacities often depend on portions of the anterior capsule rolling up and enclosing its lining of cells or even portions of superficial lens-substance, and if the membrane has not been (so to say) comminuted, but only split open in one or two directions, these opaque portions are apt to form bands standing across the pupillary area, the too limited orifice made in the capsule at the same time contracting as the whole capsule falls somewhat together centrally towards the pupil.

If the opening has been made by comminution of the capsule, but to a too limited extent, corresponding perhaps only to the middle third of its area, or to the pupillary area at the time of operation, and has not been carried behind the iris as far as the vicinity of the suspensory ligament, the margin of the orifice is very apt thus to rise afterwards across the pupil, and to require to be dealt with on a subsequent occasion.

The pricker should therefore be at first passed flat behind the iris to the farthest part intended to be opened, then its point should be turned into the lens there and brought up with slight movements, first on one side, then on the other, comminuting the capsule in its course within the line of attachment of the suspensory ligament, under cover of the iris. It may then be made to tear the central part, and finally that part nearest the external incision, where the traction instrument is about to be inserted.

Here it may be moved a little more freely, so as to break open a way for this instrument at the upper edge of the nucleus, especially if the nucleus is large, or its surface adherent to the capsule. It is essential that the pricker should be used with a light touch, that the iris should not be bruised, and that the body of the lens should not be pushed backwards or sideways by it, lest the vitreous should be burst into. The operator should bear in mind the delicacy of the sustaining tissue, and that his object is to lay open the capsule properly, without any displacement of the lens. To ensure this in the greatest degree, I always take care that the chloroform at this critical moment has made the eye quite motionless, and I hold the eye myself with the forceps both at this period of the operation and during the use of the tractor.

I attach considerable importance to another point of practice, viz., the loosening of the body of the lens from its capsule before introducing the tractor, whenever, either from the immaturity of the cataract, or the large size of the nucleus, and absence of superficial soft matter, unusual difficulty in the introduction of that instrument might be expected. In tearing open the capsule the condition of the lens in this respect is probably ascertained. This loosening I effect either by the common pricker or by the fine needle already referred to (having the point bent at a right angle), which has long been in use at Moorfields, for pulling out the lens in ordinary flap-extraction, when it refuses to escape in the ordinary way, or has dropped back into the vitreous humor. The point of this is thrust back into the lens-substance near the margin (and particularly without pressing it backwards towards the vitreous, which might force this humor out through a rupture of the suspensory ligament) so as to get a hold of it without displacing it, and then the body of the lens is slightly rotated on its antero-posterior axis to and fro within the capsule until it is felt to be loose. In immature cataracts the loosening is often attended with a sudden falling forwards, which at once explains itself to the operator.

I have come to adopt this method in certain cases, from having witnessed the failures not unfrequently attributable to the difficulty in passing the tractor behind the nucleus, when the body and capsule adhered. Every operator knows how much the risk of the ordinary flap-extraction is augmented by this adhesion of the body to the capsule in immature cataracts. The lens escapes with difficulty—more pressure on the globe is required to expel it—and portions of it are very liable to be left adherent to the capsule behind the iris, where they become a fruitful source of irritation afterwards. The same risk is incurred, but to a much less extent, when iridectomy is practised. As circumstances often are urgent against delaying operation till the cataract is more complete, I think in such cases, when the traction operation is chosen, this little proceeding is a useful addition to its safeguards; and it might be applied also, where called for, in flap-extraction.

While opening the capsule the operator at once learns the consistence of the cataract with which he has to do, and knows better how to deal with it in the subsequent steps. If soft matter is abundant around the nucleus, and sufficiently diffluent, it is well to allow some of it to escape at once by the wound. Slight pressure on the globe facilitates this, and thereby more room is afforded for the traction instrument within the eye.

The *use of the traction instrument* has next to be considered. The *course* it has to take, at first backwards and then downwards, so as to embrace the nucleus, has to be estimated with exact reference to the shape, size and position of the lens, and it is by no means difficult for a young operator to commit an error in this respect. It must pass between the nucleus and capsule without pushing the nucleus from its place, and without breaking into the vitreous humor, or bruising the iris, and if the nucleus be not already loose from the capsule, one or other of these accidents may happen very easily. The more blunt or obtuse the end of the traction instrument, the more likely is it to displace the lens in the attempt to get beyond the nucleus, and it is particularly apt to do so if it be pushed on too rapidly, or if it do not dip sufficiently behind it.

This may introduce a few remarks on the *principles to be observed in the construction of such an instrument.* It is obvious that as a comparatively small opening is made for the extraction of the lens by this method, and as the instrument which has to withdraw it has to be introduced by this opening and to be manipulated within a very confined space, the smaller its own bulk, consistently with its due efficiency, the better. I have from the first found the larger spoons of Waldau too large and cumbrous, and in the course of my first year's operations asked Mr. Weiss to make me a smaller ladle, adapted in size and shape to the posterior surface of the nucleus, but oval, using either this or Waldau's smaller spoons with a satisfactory result. In certain cases, however, as when the adhesion to the capsule was firm, or the cataract hard and large, more difficulty than usual was experienced in the introduction of the spoon, which either pushed the lens before it, or broke away through the posterior capsule into the vitreous, thus marring the operation. The ingenious spoon contrived by my friend Mr. Critchett, and described by him in the 'Lancet,' June 11th, 1864 (and 'Ann. d'Ocul.' t. 52, p. 115), slips more easily than Waldau's between the nucleus and capsule, and also obtains a hold on the nucleus on being withdrawn; and I should have been content with it but that another shape seemed still better adapted to the course it had to take, as well as to lay hold of the lens on the further side of the nucleus. In Mr. Critchett's slipper-shaped spoon, the end being wedge-like, the extreme edge by which it enters must go beyond the nucleus to a distance corresponding to the length of the wedge before the recurved edge can take hold of the nucleus in withdrawing it. In proportion as the wedge is more acute and long it will enter better, but the point must go further ere the nucleus can be seized; in proportion as the wedge is more obtuse it will enter less easily, but the point need not advance so far, and it takes a better hold; but whether acute and long, or obtuse and short, it seems to me still to occupy space disadvantageously behind the nucleus. Hence I prefer another principle than the wedge—to have the end not recurved towards the

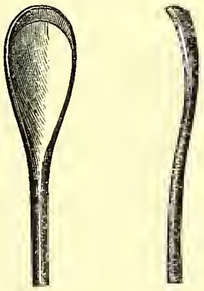


FIG. 1.

handle, but looking from it at a very obtuse angle with the body of the spoon, the extreme edge by which the instrument advances being very thin, so curved from side to side as to enter more readily, yet so square as to take a rather broad hold of the nucleus. (*See* fig. 1, enlarged two diameters.) The body of the spoon is very nearly flat from side to side, a little concave forwards from end to end, and the incurvation of the extreme end is in fact a continuation of this concavity, though inclined to it at an obtuse angle. Where the end joins the sides of the spoon this incurvation gradually ceases, and the sides, except towards the end, have no edge above the general level. The whole is as thin as posssible consistent with due rigidity, and the breadth about half or a third that of the lens. The stem is slightly curved, to adapt it to the position of the brow, across which it has to work in the ordinary iridectomy upwards.

I have found a spoon thus constructed to be very suitable in the great majority of cases, to be easy of introduction and manipulation, and also to take excellent hold of the nucleus when the handle is properly depressed at the right moment. It is also useful in withdrawing loose fragments after the main bulk has been got out.

Another modification of shape, however, seems even preferable where from the entire absence of soft surface matter there is the least room for the insinuation of an instrument between the lens and its capsule, and where therefore it should occupy the least possible space. This form is nearly flat from side to side, and but slightly concave from end to end. (*See* fig. 2, enlarged two diameters.) The end has a very thin though not a sharp edge, only slightly incurved, and the concave surface at the end is roughened by transverse lines. It is thus fitted to insert itself readily between the nucleus and posterior capsule, particularly if poised, as it were, only by the thumb and a single finger, and made to advance with a gentle lateraly wriggling motion. Then, when the handle is lowered, its end rises in the lens-substance beyond the nucleus, and obtains an excellent hold on it for its extraction. It appears to me that the double advantage of facile and safe introduction with extractile power is secured in the most effectual manner by these instruments. Both may be conveniently placed on one handle, as in fig. 3, where they are represented of the actual size.

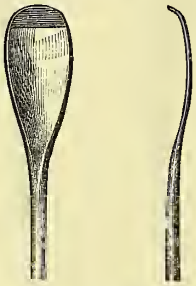


FIG. 2.

In a few instances, especially where the nucleus has been small and loose, and inclined to extrude itself through the incision at the instant of opening the capsule, I have not introduced any instrument at all into the chamber, but helped out the nucleus by the pricker, rotating it a little while slight pressure was made on the globe. In other instances I have endeavoured to pull out the nucleus by means either of the ordinary pricker, or of a two-pointed fine hook introduced through the incision; but this latter method I soon abandoned. The advantage I saw in it was the small size of the instrument used, but I found that if it was passed behind the nucleus it too readily entered the vitreous humor, and if in front of the nucleus the retractile movement was accompanied by too much pressure backwards to be effective; and moreover the vitreous was thus also endangered. It is possible, however, that an instrument shaped on this principle might be made to act with advantage, at least where the surface of the lens is soft. But in proportion as the nucleus is small and loose, the precise construction of the traction instrument becomes of less importance. If a hook is employed, it can act only on the harder part of the lens, whereas the spoon-shaped tractor is available for the softer portions also, and so is more useful on the whole.

If the nucleus is to be drawn out with safety through an opening only just large enough for it, it must be supported behind by a somewhat flat or concave instrument, which must be so shaped at its end as to grasp, as it were, the further side of the nucleus. This grasping power, obtained by an incurvation of the further end, should be so effectual as not to render necessary too much pressure of the whole lens forwards against the iris and cornea, whereby the iris might be bruised. The lens should be well held by the instrument, so as to be withdrawn without pressure either forwards or to either side. The act should be one of *traction*, and this should usually be unaided by any *expulsion*, any pressure or pull on the globe. If any such is employed it should be remitted as the nucleus is emerging, so as not to risk the loss of vitreous humor. It is very rare, however, for any such loss to occur.

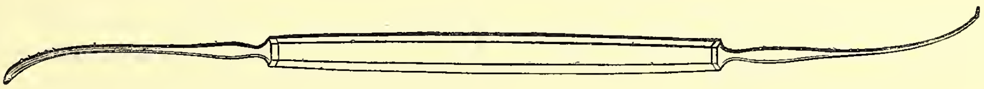


FIG. 3.

Doubtless a chief disadvantage of this method consists in the liability to detach marginal portions of the cataract, and to leave them in the eye, where they may irritate the iris or angles of the wound. It is most desirable to secure, as far as possible, the withdrawal of the lens *en masse* by having the incision sufficiently large, and by the utmost delicacy in manipulation. Should fragments either hard or soft, but especially hard, remain behind, they are to be got away by careful re-introduction of the same instrument, or of one more suitably shaped for that purpose. A smaller spoon or the ordinary curette may serve very well. If the anterior capsule have not been widely broken open at first, the fragments may lie beneath portions of it, and so elude the instrument. It is then better to leave them there than to make too many attempts to remove them, for in these attempts the iris is very apt to be contused, or the vitreous to be broken into.

If the posterior capsule have been unfortunately ruptured, the vitreous humor may envelop fragments and press them against the iris. Some of these may perhaps be got away easily, but failing this they should be left in. In such a case we need not be too anxious to limit as much as possible the loss of vitreous. The eye often seems even to do better with a loss of two or three minims than of one; and if any at all be lost, there is often an advantage in encouraging the loss to this extent.

At all events we need then have no hesitation in dipping in the curette to fetch out fragments of lens, even though at such a loss, if we are only careful not to bruise the iris. Portions of vitreous humor lying near the iris during the few days subsequent to the operation no doubt constitute a certain risk, because they may entangle portions of lens and mechanically irritate it, and because, if any inflammation arise, they form a stratum to which lymph easily clings, and thus serve to shut off the aqueous from the fragments, and delay or prevent their absorption. I have now and then extracted such enclosed fragments unaltered months afterwards, when dealing with an occluded pupil. If a considerable quantity of the front and central portion of the vitreous have escaped, what remains in the anterior chamber and pupil on the completion of the operation soon falls back from the pupillary region as the aqueous is re-secreted, and the iris and lens-fragments are thus left more free in aqueous humor, and the above risks are much diminished.

It is nevertheless, of course, better to extract all fragments if it can be done with safety, and I may here mention my suction-syringe, with a larger orifice than usual, as of great use in this respect. Fragments which refuse to be brought out by the curette or spoon will often be completely manageable with the syringe. The sucking orifice admits of being turned in any direction, so as to seize such fragments without interfering with the iris at all.

What has now been said will perhaps be sufficient to explain all the more important details regarding the use of the tractor. I have only to add that if it should happen that the suspensory ligament gives way so as to occasion loss of vitreous humor either before or after the iridectomy, but before the opening of the anterior capsule, the better plan is, after completion of the iridectomy, to dip one of Waldau's larger spoons well behind the lens, and extract it in its capsule. Sometimes the lens is loosely hung, and the vitreous prone to burst forwards, whatever operation for extraction be performed. In such cases the traction operation has manifest advantages over the old flap method, not only by the small size of the section and the impossibility of subsequent *prolapsus iridis*, but by the far greater facility it affords of pulling out the lens.

When the lens is done with, any fragments or strings of coagulum remaining about the angles of the section are to be cleared carefully away, the wire speculum removed, and the lid closed. It seems to matter little what applications are subsequently employed. A piece of fine linen, covered with cotton-wool or charpie, and retained by a suitable bandage, affords a support which is well adapted to the first few hours after the operation, especially if vomiting occur. If the bandage proves hot, or if the lids are irritated by its movements, acting through the linen adhering to them, a simple wet rag often renewed may be substituted for it. The comfort of the patient is generally the best guide. Atropine lotion or drop is indicated if any fragments of the lens have remained in the eye, and a few timely leeches near the outer canthus if pain occur, especially increasing or throbbing pain; but these are very seldom needed.

After-course and Treatment.

The management of the eye after traction operations does not seem to demand any special remarks. It will, I think, be generally found more simple, and attended with less anxiety to all concerned, than that following ordinary extraction. This results chiefly from the smaller size of the wound, and the immunity from prolapse. The room should of course be shaded, but the patient may be up or in bed, and may sleep in any posture; the hands need not be restrained during sleep; coughing or sneezing cannot disturb the wound; if inflammation occurs, the eye can be examined without risk, and the requisite applications made to it; it may safely be washed even by the patient himself. Were it necessary I could adduce many striking facts in corroboration of these remarks, several of them relating to instances in which one eye had suffered from the accidents incident to flap-extraction, but where the traction operation performed on the other eye was afterwards attended by the best results.

It is no part of the object of the present paper to describe at length all the modes in which an operation by the method of traction may fail. It must certainly be expected that in a large number of operations some will be completed with less perfect fulfilment of all the indications than others, and that even among those cases in which all the steps are perfectly accomplished some will, from unexplained causes, suffer more than others during the healing process. The flap and the traction operation both involve the risks incident to an incision into the coats of the eye. The wound may fail to heal in a kindly manner, may go on badly in a variety of ways. The advantage of the traction wound is that it is smaller, that it can hardly undergo displacement, or be complicated by any prolapse: it also admits of being more safely examined, and, if necessary, topically treated. Both operations involve a danger of iritis, but the large size of the iridectomy-pupil gives more room for any loose lens fragments, which, therefore, are less apt to be injurious as mechanical irritants to the iris than after flap-extraction, when the pupil closes upon them the more, the more the iris is inflamed. Serous iritis of low and obstinate character may also follow either operation, as may suppuration of the globe, and other occasional or exceptional results.

Results of the Traction Method.

Time has so confirmed my early good opinion of the traction operation as to lead me to apply it each year since 1860 to a continually augmenting number of cases, and as experience has accumulated I find the average of success has risen. It has uniformly been higher than that of the flap operation in my hands. I have taken some pains to ascertain the final results of my cases, and from a careful review of all those of which records have been kept, amounting to more than a hundred and thirty, I feel able to speak with some confidence on the subject.

1. The *first* class are those in which *the power of reading a small type* (viz., up to No. 6 of Jäger) has been obtained. Several of these have been able to see No. 1, and many Nos. 3 and 4, but all have been able to read No. 6. The average number reaching this degree of success has been 68 per cent., or taking only cases treated in private, they have been 75 per cent., or three-fourths of the whole. Of these last, 55·8 per cent. have not required any secondary operation, 19·2 have attained the result only after a needle operation on the pupil.

2. The *second* class comprises cases in which the power of seeing a type ranging between 6 and 14 of Jäger has been gained, which might be termed very useful sight for all ordinary purposes. The number of these cases has been in all 14·5 per cent. Of this class the cases treated in private, if separately enumerated, rise only to 13·4 per cent., a greater number having probably been raised by secondary operation out of the second into the first class in private than in hospital practice.

3. The *third* class comprises such a very limited result as allowed of the patients having fair perception of light of colours, of large objects, of fingers held a foot off, and of seeing their way about in an accustomed place, only some slight improvement, in fact, of their previous condition of complete cataract. These are in all 9 per cent., or of the hospital cases 11·4 per cent., and of private cases 5·77 per cent.

4. The *fourth* class are lost eyes, either bare perception of light, or none. These are (all included) 8·4 per cent., or of hospital cases 10·1 per cent., of private patients 5·77 per cent. Thus also classes 3 and 4 show a higher verage of success in private than in hospital practice.

In judging of the real meaning of these results, it must be borne in mind that there has been no selection of cases most favourable for the operation. All are noted of which record has been kept, and all patients were operated on to whom it seemed right to offer the chance of an operation, though that chance might be a slender one. Indeed, it may be truly said that the list contains a more than average number of unpromising cases, since the cases selected during the same period for flap-extraction have been generally those of uncomplicated nature, the traction operation having been adopted in almost all those of the more doubtful kind, according to the indications laid down in the earlier part of this communication. And several of the more satisfactory results have been obtained by the traction operation on the second eye when the first, from one cause or another, had gone on badly under flap-extraction. It is my decided conviction that had the same series of cases been operated upon by the flap method, the results would have been much inferior.

On Capsular Obstructions, and their Treatment.

Allusion has been just made to secondary operations on the pupil required in some instances of the traction operation. Capsular obstructions have been hitherto chiefly studied after flap-extraction, or after needle operations either for depression or solution, where the pupils, if not closed, have usually been of small size, and the precise nature of the obstruction, therefore, often hard to scrutinize. The larger size of the pupils left by a mode of operating of which an iridectomy forms an essential part, has made it possible to study the physical characters of such obstructions with more precision, and to lay down some rules for their treatment, which it may not be inopportune to allude to briefly on the present occasion, although the subject is in itself sufficiently important to warrant a more extended notice. I believe many persons are allowed to remain with a much more imperfect sight than is attainable, through such obstructions being overlooked, or, at least, not operated on; and also that some others, in whom a secondary operation is undertaken, fail to reap the benefit of it through some defect in the manner of its performance, or in its after-treatment.

In speaking of the mode of opening the capsule, I insisted on the desirableness of completely breaking up its anterior portion nearly up to the circle of attachment of the suspensory ligament. I do not say that on every occasion this can be perfectly accomplished. The escape of fluid or soft matter on the first rupture, or the presence of a little blood, or the narrow dimensions of the pupillary area, or something in the position or movements of the eye may now and then render it difficult, but it is always to be attempted. If the central area opened up be too small, or if the anterior capsule be rather split open than comminuted, portions of it are very apt to remain athwart the pupil afterwards, and to become a cause of imperfection in the retinal image. They may do so—

1. By affording a surface on which effusions of lymph may rest with or without particles of lens-substance entangled either in their folds or between the anterior and posterior portions of the capsule.

2. By becoming even without apparent inflammation the seat of opacities slowly formed on the inner surface of the capsule by an imperfect process of growth from the lining of intra-capsular cells, which last, as Dr. SCHWEIGGER has shown, may remain attached to the capsule even when it has been freely broken open and exposed to the action of the aqueous humor. No doubt this imperfect cell-growth does not go on interminably. It seems particularly apt to occur in portions of the capsule, which have retained in some degree their natural separation from the aqueous humor by becoming shut up within the involutions which this membrane is prone to form when, on being ruptured, it rolls up in a direction contrary to that of its normal curvature when unbroken;* also in cases where the opposed inner surfaces of the anterior and posterior surfaces of the capsule have fallen together, with or without the interposition of some remaining layer of adherent lens-substance. If such surface structure is included, it may indeed become the source of new lens-growth of very appreciable thickness, usually opaque, but occasionally, as I think I have seen, having in some degree, and for a time, the transparency of natural lens-substance. Both these varieties, but rather the former, may in process of time assume much toughness, especially if inflammation have added to them any fibrinous films.

3. By the capsule becoming not opaque itself, which perhaps it seldom or never does, nor the bed to which opacities adhere, but simply wrinkled and folded in such a way as to refract the light unequally in its passage, and consequently to confuse the image. It is to this particular cause of imperfect sight that I wish to draw attention.

Nothing perhaps has occurred in the course of the convalescence to excite any suspicion of an imperfect result. The eye has been originally a most promising one, the pupil active, the tension natural, and no pain or inflammation has succeeded the operation. The patient declares he sees objects brightly, yet on a trial with the usual series of lenses no clear image can be obtained. At an early period, perhaps, *i.e.*, within a few weeks, the acuteness is indeed considerable; but on subsequent trials, weeks or months afterwards, a deterioration seems to have occurred, which is often not unnaturally attributed to a failure of the retinal power, because no inflammation has been noticed, and on a cursory examination the pupil exhibits no opacity sufficient to account for the defect. On lateral focal illumination a very delicate film may perhaps be detected, but even this not necessarily, and it is altogether much less in amount than what the surgeon often sees to be compatible with much better vision than that which he finds to exist in the case under his inspection. The ophthalmoscope now comes to his aid, and is the best discriminator of the actual condition. He finds that no sharp image of the fundus, and particularly of the optic disc, can be obtained. The situation of the disc is detected by its whiteness, and perhaps, according to the degree of the capsular fault, its general shape, or even its vessels, may be observed, but irregularly distorted, as though seen through finely wavy glass. As his lens moves, the image of the disc is seen through successive portions of the pupil, and is seen differently according to the variation in the capsule at different points. Finally, keeping the optic disc in his line of sight, as the best foil by the whiteness of its reflex, he brings the lens sufficiently far from the patient's eye to have the capsule itself in its focus, and he then sees the actual wrinklings of the transparent membrane by means of the various inclination given by its folded structure to the rays of light. There are dark and bright lines or streaks varying with every movement and slope of the lens he holds, indicating the lines of direction in which the emergent light is so deflected that it fails to meet his view, or comes in augmented intensity. It is a phenomenon not dissimilar in its nature from that observable in conical cornea, but in this latter there is more distortion of the optic disc as a whole. It is seen, perhaps very distinctly, but much distorted, whereas when observed through these fine multitudinous wrinklings its general shape may not be far from natural, though the parts of which it is made up are comminuted or broken up, so that its details cannot be discriminated.

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* *Vide* 'Lectures on the Parts Concerned in the Operations on the Eye,' London, 1849, page 63.

I have hitherto spoken of obstructions formed by the anterior capsule. It is obvious that the two first forms above enumerated (the capsular *opacities*) may either necessarily or probably involve the posterior capsule also; but the wrinkling of the still transparent capsule spoken of under the third head is much less apt to do so, though it occasionally may; for in the operation supposed, the rim of the capsule and the posterior layer are untouched, and consequently the rim does not fall much together, and any shrinking of the posterior capsule afterwards is likely to be even and uniform, and were it otherwise the greater tenuity of this portion would render it less disturbing by its false refraction than a similar folding of the anterior part. Moreover, I think it probable that as the eye settles into its ultimate balance of tension and position of textures after the operation, the vitreous humor, where bounded by the posterior capsule, falls sufficiently forwards to have rather a convex than its former concave shape, and that then the posterior capsule becomes somewhat convex forwards, and wrinklings in it are avoided. Such a convexity of the vitreous in the pupillary area, even if unsymmetrical, would hardly mar the image in any sensible degree, since the index of refraction of the vitreous differs so little from that of the aqueous. Nevertheless, I have sometimes thought that such an abnormal form of the front of the vitreous, if presenting a very sloping surface forwards, has really been of some detriment, where the media in the pupil presented absolutely no opacity.

And now, as to the principles which should guide us in dealing with such capsular obstructions by a supplementary operation. The question is an important one. Patients not seldom dislike an additional operation, particularly as in few cases can we truthfully aver that they run no risk whatever by undergoing it. Particular reasons may vary in different cases, but in general I should advise a patient to be content without a secondary operation if he is able to read 5 or 6 of Jäger. If the wrinkling of the capsule, however, be in such a case the sole obstruction, and he wishes to see still better, I am quite willing to tear it through, using the precautions presently to be described. In general, no operation should be undertaken until the eye is entirely free from any inflammatory or congestive tendency that may have followed upon the original operation.

1. In contemplating any operation on a capsular obstruction of the pupil, the first thing is to ascertain as far as possible its exact nature, whether it is complicated or not with any adhesions to the iris, and if so, where these lie, and what is their extent. We should examine the mobility of the pupillary margin under varying light, and its exact behaviour under atropia, following this up by lateral focal illumination, and, above all, by such an opthalmoscopic examination of it as has been above alluded to. The precise condition in each individual case ought to be present in the operator's mind ere he proceeds to deal with it instrumentally. The ophthalmoscopic examination after atropia should immediately precede the operation, that the picture of the parts may be in his mind, and he must remember that the view of the pupil as the patient lies on the operating table is a different one from that previously obtained, and generally insufficient of itself to inform him of the real nature of the obstruction.

2. Dismissing for the present those cases of denser opacity, with cicatrized, contracted, totally adherent pupils, the result of chronic inflammation, and confining my remarks to the ordinary obstructions following the traction method, in which the pupil is not much smaller than it was made by the operation, the following rules are to be observed:—

(*a.*) Chloroform may or may not be given, but if wished for, it may as well be given to a slight extent, so as to lessen the sensibility, but not to produce unconsciousness, the patient being told to restrain his movements. I have not found any inconvenience from doing this. If he should prove uncontrollable it may be given to a greater extent; but the operation is brief and never very painful, often it is hardly felt even without chloroform. If this is administered, however, the globe may be held with less compunction by the forceps, and to do so certainly adds to the precision of the steps.

(*b.*) Two needles should be at hand, so that the second may be used if required. Both should be as fine as is consistent with strength: they should be cutting for a twentieth of an inch at the spear points; the stem should be cylindrical, should enter and move backwards and forwards easily in the corneal puncture, which it should at the same time perfectly fill, so that no aqueous humor should escape until the instrument is altogether withdrawn. When the operation is over, the needle should be withdrawn gently, and the lids at once closed, so that no pressure on the globe follows. In this way it may often happen that almost no aqueous is lost even through two corneal punctures: from which the advantages result of no bursting forwards of vitreous humor through the pupil, no displacement or stretching of the pupillary margin or iris, and none of the pain and after ill-effects often due to this latter cause alone. I mention these points advisedly, because, though the importance of having such needles has been again and again insisted on, and is now well understood by many, yet bad needles not fulfilling the above indications seem to be in too common use. The needle also should pierce somewhat obliquely—say at an angle of about 60° or 70° with the perpendicular—if entering too vertically the aqueous more readily escapes afterwards, if too slantingly its corneal track is too long, and it works less easily in different directions, and not without stretching the corneal tissue. As it has usually to be introduced near the corneal margin, a direction thence to the opposite side of the pupil will usually have the right obliquity.

(*c.*) If any considerable part of the pupillary obstruction consist only of crumpled capsule without opacity, that part principally, if not solely, should be selected for operation: the point of the needle should pass to its further side, should cut it through in different directions without entering deeply into the vitreous humor, and should, so to say, comminute it, without any drag on the contiguous parts either of the capsule or iris. If a free opening be thus made it will be effective for a clear image, even though diffused shadows be still cast on the fundus by films of opacity in neighbouring parts of the pupil, and I would advise that no attempt be made in that case to remove such opacities, unless, being very brittle, they yield to a slight touch of the needle, or unless they occupy a considerable proportion of the pupillary area.

(*d.*) If it is desired to break through such denser or adherent films, which resist a single needle, the second one, held in reserve, is to be introduced with the other hand. The first should have already cut across the film or separated it if adherent, in so far as it could do this without a drag on the iris or ciliary body, and the capsule has thus perhaps been reduced to one or two strings tougher than the rest. The second needle is then inserted in such a position as may best secure the rupture of these bands in the usual way, their points crossing, one in front, the other behind the band, and revolving a few turns round each other, and then perhaps being separated.

(*e.*) As it is of prime importance that this little operation should not be followed by iritis, it will be well to let any unavoidable drag upon the iris be a gradual one. This tissue will yield to a gentle continuous force, while one suddenly and roughly applied will do it violence, and excite it to inflame. The movements of the needles should therefore be slow, not jerky.

(*f.*) The vitreous humor should not be encouraged to come through the opening made in the capsule. To retain the aqueous and favour its speedy re-accumulation in the manner above alluded to is one means of ensuring this. Another is to avoid running the needles too deeply into the vitreous, or making too wide excursions there, so as to break it up. I think it often happens that this humor is more fluid in its axial region, behind the pupil, more consistent near the ciliary region. Wide excursions of the needle, pushing the pupillary margin towards the ciliary region, are apt to disturb this latter part of the vitreous, and cause it to press thence afterwards through the pupil, occasioning irritation of the iris by displacement, and sometimes consequent heightened globe-tension of the glaucomatous type.

(*g.*) Such glaucomatous tension is particularly apt to come on after needle operations following flap-extraction, where the pupil is small, and disposed by the integrity of the sphincter to remain small afterwards, as well as to suffer at the moment from the dilating force of the needles. It is very much less apt to ensue upon a similar proceeding following the traction method, and this indeed constitutes one of the subsidiary advantages of this latter method. Nevertheless a few words here may be added regarding it. I have formerly alluded to it in speaking of glaucoma. (*See* 'British Medical Journal,' Jan. 30th, 1864, p. 135, and Teale, *ibid.*, p. 404.)

This glaucomatous hardness is by no means an indication or result of mere iritis. Considerable iritis may follow a capsular operation, and even last many months without any increase of tension: and, like ordinary idiopathic glaucoma, this glaucomatous state may commence without inflammation and remain long without pain, though it is far more commonly attended by both. It may come on within twenty-four hours after the needle has been used, but usually on or after the second day. The patient does not then see so clearly as immediately after the operation, the eye is a little hard (T1), it is perhaps hardly redder than natural.

Within twelve or twenty-four hours, perhaps in the night, ciliary pains in the brow or temple come on, and the eye is found still harder (T2 or T3). With the higher tension there is more injection, but chiefly of small ciliary vessels, and vision is more obscure, but on examination of the media there is little to account for this, the cause being, not their opacity, but compression of the retina. But probably the iris will be found more or less bulged forwards, showing accumulation of fluid behind it in a space not communicating through the pupil with the anterior chamber. Often this bulging is partial or unequal, occasionally the pupillary margin is thrown aslant by it. Whether the over-secretion indicated by the bulge, by its reaction on the other contents of the globe, is the sole source of the heightened tension, or whether, as I am rather inclined to believe, the displacement and stretching it causes in the iridial tissue becomes the excitant of the vascular nerves governing the secretion; according to the views of Professor DONDERS, it is certain that a puncture of the bulging iris with a broad needle, opening a communication with the anterior chamber, usually suffices to relieve the heightened tension, and to cause a subsidence of the rising inflammation. This therefore should be made at the earliest moment that the globe is found to be too hard, at least if the hardness rises to T2, and persist after twelve hours from its commencement. Atropine should certainly be used, but it is often a mistake to apply leeches, or to trust to any remedy short of local relief by puncture; and if this be necessary, the sooner the better; for then all the secondary evils of the glaucomatous state may be averted, which otherwise may be expected to develop themselves sooner or later, according to the intensity of the inflammatory symptoms.

(*h.*) It is chiefly on account of the liability to this glaucomatous state that an eye should always be carefully watched for some days after the needle operation, and no premature use or exposure to light permitted. But by attention to the points of practice now insisted on, I think such state will be rarely excited, and that if at once recognized it may be readily relieved.

Proposals entitled to great respect have been made within the last few years, by one of which (that of JACOBSON) the old flap operation has been varied by the performance of an iridectomy after the flap has been formed and before the opening of the capsule, the intention being to facilitate the egress of the cataract, and to obviate the troubles of after prolapse of the iris. As no traction instrument is here used, the flap must be large, and chloroform therefore is not prudently admissible. The operation too without chloroform is considerably complicated and prolonged by the iridectomy, and made more painful, and loss of vitreous is therefore prone to occur. I have performed it a few times, but have not been satisfied with it. Before the formal proposal of this as a method, I had now and then in flap-extraction excised iris after the extraction of the lens in cases where there was a strong disposition in the iris and vitreous to bulge and distend the flap; also where vitreous had already escaped I have removed a portion of the iris with advantage.

Another proposal (that of VON GRAEFE) has been to make an iridectomy as an altogether preliminary step, and to wait until the eyes had recovered from this operation before removing the lens, either by the large flap or by the smaller incision with the help of a traction instrument. With respect to the former alternative (by the large flap), a preliminary iridectomy would no doubt disarm it of some of its attendant hazards, and chloroform may be given for the iridectomy, though not for the extraction. Probably such an extraction would be attended with more risk of loss of vitreous than the ordinary flap method, without iridectomy, but certainly the recovery from it would be on the average a safer one. With regard to the latter alternative (by the smaller incision and a traction instrument), chloroform is admissible at both parts of the two-fold operation; but then it may well be questioned on what adequate grounds the patient is to be subjected to the inconvenience and anxiety involved for the most part in this double proceeding, when a single operation under chloroform, according to the method advocated in the present paper, will suffice.

On the whole, the experience I have acquired induces me to draw the following conclusions:—

1. The operation described may be applied to all cataracts of harder consistence than those which admit of being withdrawn through a puncture of the cornea.

2. The iridectomy, which is a necessary part of it, is no disfigurement, nor does it in an appreciable degree affect the optical result.

3. This operation is superior to flap-extraction by being applicable under chloroform, by its diminished risks during convalescence, and by its greater average success, and by being now and then admissible where flap-extraction would be attended by so little prospect of advantage as to be hardly worth performing.

4. While therefore flap-extraction may still be preferable under certain circumstances, and while it may be open to the future to render its success more secure under various conditions, a general adoption of the traction method would be likely, at present, to add considerably to the percentage of cases of cataract in adults recovering sight by operation.

XXI.

OPHTHALMIC MISCELLANIES.

By William Bowman, *F.R.S., in* '*Ophthalmic Hospital Reports,*' 1866, *Vol. V, pp.* 1–15.

No. I.—CASES OF MALFORMED, MISPLACED AND DISLOCATED LENSES, IN SOME OF WHICH GLAUCOMATOUS SYMPTOMS WERE DEVELOPED.

(*Abbreviations used in this paper:*—J = Jäger's text types. OS = ophthalmoscope. Od = optic disc. F = visual field. T = intra-ocular tension, as follows:—Tn = tension normal. T1? = doubtful increase of tension. T1 = slight but positive increase. T2 = a higher degree, but the globe still impressible by the fingers. T3 = the eye not impressible, stony hard. –T1? = doubtful decrease of tension. –T1 = slight but positive decrease of tension. –T2 = another degree of slackness. –T3 = the globe so soft as to allow the fingers to sink in it. These two last degrees are indefinite. (*See* 'British Medical Journal,' October 11th, 1862.) ′ = English foot. ″ = English inch. Hm = manifest hypermetropia (*see* Donders, 'On Anomalies of Accommodation and Refraction of the Eye,' where many other useful abbreviations or signs are given). With the better definition of scientific ideas, such abbreviations become more precise in their meaning, while the constantly augmenting volume of scientific literature makes them more and more necessary. It might be well if the ophthalmologists of all countries, to be represented at the Vienna Congress next year, would take steps for some common understanding on this subject.)

The following case is interesting in two respects:—First, as an example of a somewhat rare malposition and defect of the lens, originating during the developmental period, and illustrating the serious risks to which such imperfect eyes are liable; secondly, in its bearing on the explanation of those morbid variations of intra-ocular tension, whether by excess or deficiency, which at present form one of the most important subjects of ophthalmological inquiry.

Case 1.

The patient was a well-built cabman, æt. 22, who had always been considered "short-sighted." With the right eye at 4 inches he could read J1, provided he held the head downward and a little to the right side; with the left eye only J6, and that with the head erect. Both eyes were of good size and appearance; the anterior chambers were of ordinary depth, but the irides trembled when the eyes moved, especially in certain positions of the head; and it was noticeable that when the face was inclined downwards the iris advanced, especially the right, and the nasal side of it more than the temporal. The pupils acted promptly and freely, and when they were expanded the lenses could be seen by the OS to be rather small, and placed too high, as well as somewhat inwards, so that their lower margins crossed the pupil obliquely. The fundus of the eye was clearly seen through the lens in the higher part of the pupil, while through the lower part of the pupil it was seen as in cases of aphakia. Very faint marginal opacities existed in both lenses, only discoverable on close inspection. The man had never experienced any trouble with his eyes till the winter of 1863-4, when he was 22 years of age, and when the following circumstances occurred in connexion with the *right* eye, the left remaining quiet:—

On three occasions, at intervals of about a week, he awoke with the eye dim and misty, soon accompanied by pain in the eye or brow, but towards the middle of the day the symptoms remitted, and he saw as before, forgetting the occurrence till again reminded of it the following week. He came to Moorfields on the third of these occasions, when, at 11 a.m. the tension of the eye was found augmented, T1, there was hardly any anterior chamber, the iris was not tremulous, being almost in contact with the cornea, especially at the inner side, where it was evidently bulged forward by the lens. The pupil was dilated, irregularly oval, and inactive; the conjunctival and sclerotic vessels were congested, with considerable pain and aching of the globe. The visual field, F, was complete, but vision everywhere dull. Fingers could be counted at 1 foot. The eye was kept under observation. At 11.30 a.m. the anterior chamber was found less shallow, the iris not so advanced, the pupil circular and more active, and the pain nearly gone. Tension still T1. At 12 o'clock the anterior chamber was restored to its natural size, the iris tremulous like the opposite one, the pupil active, the mistiness less, no pain, and T1?

I ordered the man to come daily to my house that I might more accurately study these remarkable phenomena. The next day, February 3rd, he came at 11 a.m. There had been no return of dimness. The right eye was Tn; he could see J1 at 4 inches; the lens and iris were in their usual state, as described in the opening statement.

I now directed him to alter his posture, to see whether the lens would vary its position, as he thought the pain and dimness had first come on after stooping. He was made to sit with his head held down in a stooping posture from 11.10 till 11.35, but no inconvenience ensued. When he leaned forward the pupil only became dilated, and when he leaned back, so that the eye looked upward towards the light, the pupil contracted. Next, the head was held downwards, and to the right side for ten minutes, and again downwards and towards the left side, but with no perceptible result.

He was now told to return immediately whenever the symptoms might recur, and he presented himself on the 7th, at 11 a.m., saying that the eye had been dim and painful as before since he awoke. He could only see J14, and count fingers at 3½′, T1. The pupil was oval and dilated, the anterior chamber very shallow and unequal, the globe acted, and the conjunctival and sclerotic vessels were injected. By the OS the lens was beautifully seen dislocated forwards obliquely half through the pupil, the outer and lower margin being in front of the iris; there also seemed a general slight haze of the surface of the lens, with fine marginal striæ, not previously so apparent. The red reflex of the fundus was distinct on the inner side, but the od was not distinguishable. This condition gradually passed off as before, without treatment.

On the 9th the same kind of attack recurred, but he did not return to me till the day following, the 10th. He then stated that the pain and dimness, instead of clearing off towards noon, had continued all day, getting worse towards evening, and having been severe all night. When he came at 11 o'clock on the 10th the pain was great, with much congestion and watering, a very shallow anterior chamber, the pupil oval and dilated, the iris not tremulous, and slightly discoloured. He could count fingers at 2′. No iridization. I expected to find the tension increased but it was normal, Tn. At 12.15, the pain continuing, a solution of atropia of one grain to the oz., was dropped in several times, at intervals of five minutes, and seemed to relieve the pain, though it had no effect on the size of the pupil. To take one grain of opium at bed-time, or earlier if pain returns.

11th.—Slept well. No pain since yesterday but the eye much injected, and the iris discoloured. Though the anterior chamber is again of good size, the pupil remains ovally dilated, now probable from the atropia, since it is tremulous, and apparently not displaced by the lens, which has fallen back to its original place, though tilted. Vision very misty. He only counts fingers. The cornea is a little hazy, the vitreous also a little turbid, and the fundus not visible. The tension of the eye was now found not augmented, not even of normal amount, but diminished, -T1.

12th.—Still no pain, but the cornea more hazy, with more vascularity of the globe, and he cannot even count fingers. The tension still less, -T2. The iris was fairly visible, tremulous, nearly in its natural plane, the pupil smaller and nearly circular (the atropia having been omitted) and the lens not advanced. The fundus of the eye could not be seen, owing to the general cloudiness, chiefly of the vitreous.

It was now necessary to devise some treatment for our patient or to abandon the eye to its fate. After [dislocation of the lens forwards, the globe had become glaucomatous, for a time; the heightened tension had then given place to a morbid slackness, and though the lens no longer pressed upon the iris, the congestion was increasing, and the vision nearly gone. If the symptoms could be supposed likely to yield to any general treatment, the eye would still be liable to a recurrence of them all on the next dislocation of the lens; but I could not say I thought it possible to escape the entire loss of the eye by anything but operation. I therefore determined at all events to remove the original cause of the mischief by extracting the lens, and in doing this to excise a portion of the iris, without indeed having any very definite idea of what the immediate effect of this operation might be on the intra-ocular circulation and tension, though I could not but watch the effect in these respects with much interest. Chloroform was immediately given and the iridectomy made outwards because it was in that direction that the lens had projected through the pupil. On completing the section of the corneal margin a bead of vitreous protruded in such a manner as to show that it was still contained within the hyaloid capsule. After the iridectomy the lens was removed without difficulty by a small scoop, a bead of vitreous, remaining in the wound, being snipped off with scissors.

The lens was found to be altogether *too small and too convex*, very like the lens of a young child. Its equator was not circular, but irregular, in a way to give an indication of the trilinear arrangement of the segments, *i.e.*, it approached in a slight degree to a triangular outline when seen from the front or back. No suspensory ligament was discoverable, so that it seemed that what remnant of this structure had previously held the lens in its position had been broken through during the operation at the capsule of the lens, not at the ciliary body. The capsule was entire and quite transparent, and the body of the lens almost, if not quite, transparent also.

During the 13th, 14th, and 15th there was no pain, and the eye seemed to be recovering, becoming gradually less vascular and the vision better. The tension remained –T3 or 2. The further progress was steadily towards recovery, and may be most simply stated by a transcript of the notes as follows :—

16th.— –T1. Sclerotic injection chiefly about the wound; cornea much clearer. Sight improving ; can distinguish faces.

24th.— –T1. Slight injection at the wound; cornea quite transparent; good anterior chamber. Diffuse haze of the vitreous. Fundus not seen. With $\frac{1}{2\frac{1}{2}}$ reads J13.

27th.— –T1?. Vitreous hazy still ; reflex better, but od not seen.

March 5th.— –T1?. Vitreous still hazy, and flocculi visible by the OS ; the od indistinctly seen. With $\frac{1}{2}$ reads J8.

12th.—Tn. The vitreous is clearer, and shreds are seen on it, moving with the movements of the eye.

19th.—Tn. With $\frac{1}{2}$ reads J3.

26th.—Tn. Slight films still seen in the vitreous; od plainly seen, its colour rather resembling that of the neighbouring fundus; arteries small. With $\frac{1}{3}$ reads J20 at 15 feet, and with $\frac{1}{2}$ J1.

April 9th.—Tn. No morbid vascularity, except just at the cicatrix. The eye is "quite comfortable" and (with the lens) "the best of the two." With $\frac{1}{2}$ reads J1.

In connexion with the above case, so far as its interest lies in the glaucomatous state induced by the dislocation of the lens, the two following of traumatic dislocation with glaucoma may be here related.

Case 2.

A clergyman, æt. 37, who had Hm $\frac{1}{12}$ in each eye, and who had formerly been successfully operated on for internal strabismus, chanced to have the right eye hit by a morsel of wood, which was being chopped. After the immediate pain of the blow had subsided by simple treatment, he seemed to be recovering, and did not apply for aid until the 4th March, 1864, three weeks after the accident. Great pain had suddenly come on four days before, and had lasted ten hours. The tension of the eye was augmented, T1. F complete. Could only see J18. The cornea and vitreous were rather hazy, but the OS gave a fair reflex, and though the od was not visible, there was no manifest hæmorrhage. The pupil was much dilated, and the lens, though quite behind the iris, was seen to have dropped somewhat downwards and inwards, so that its upper and outer edge crossed the pupil above, leaving an interval through which a portion of the vitreous humor appeared to project into the interior chamber. The capsule of the lens was unruptured and the lens was transparent, but as the light fell in different directions from the OS, dark striæ (which I call *striæ of refraction as distinct from striæ of opacity*) were seen, indicating some derangement of the marginal fibrous laminæ. Such striæ I have very often seen, and I suppose they must have been seen by others, as a condition that long precedes, in certain cases, the opaque or cataractous degeneration of the lens. Here they were probably due to the mechanical injury.

Under strict rest and antiphlogistic measures, with the use of atropine, some improvement occurred, and on the 10th he could see J14, and with $\frac{1}{12}$ letters of J6. But the tension continued T1.

17th.—T1. Ciliary vessels injected; front of sclerotic red. Eye weak, watering, and intolerant of light. With $\frac{1}{12}$ J8.

21st.—T2. With $\frac{1}{12}$ J10. Cornea and fundus duller; lens more advanced, pushing the iris slopingly forward, so as to render the anterior chamber shallow. The eye was more painful. He had now also, for the first time, iridizations; a candle was surrounded by an orange, yellow, and blue halo, the colours not being bright.

I now determined, as in the preceding case, to attempt relief by operation. Under chloroform, a marginal incision of two lines was made upwards and outwards by a Sichel's knife and a bead of vitreous, which at once protruded apparently in the hyaloid tunic, was snipped off. A spoon was now passed behind the lens and its capsule and the lens, rupturing in the attempt, was withdrawn in two or three portions; but as it was transparent, some fragments were probably left. More rather solid, clear vitreous protruding, in all about five or six minims, was now snipped off by scissors, and the eye closed. No iris was removed, as the instruments failed to take hold of it, the vitreous folding it backwards above and behind the corneal section, as usual in such cases. It will be seen that it would have been better if it could have been excised at the time. After operation, –T2.

22nd.—No pain; but some swelling of the lids, Tn. Two leeches were applied.

23rd.—More pain; the swelling of the lids extends to the temples, and the leech bites are suppurating. Some chemosis. Goulard lotion.

After this the tumefaction subsided gradually. The tension of the eye was then found normal.

On the 26th he could see the hand, but could not count fingers. The next day he could count fingers held close; the following day at 4′.

On the 30th, with $-\frac{1}{2\frac{1}{2}}$, J15. The centre of the section gaping, and the iris protruding there, was snipped off on the 31st.

On April 11th the eye continued red, but pain had quite ceased.

On May 10th, redness nearly gone, but returned on use. Tn, with $-\frac{1}{2\frac{1}{2}}$, J8. After this the eye became strong, and the vision still improved when he was last heard of in January, 1865.

Case 3.

A little boy, 8½ years old, in the middle of May, 1863, had the right eye hit by a child's blunt arrow. The lens was thrown upwards and outwards in the direction of the ciliary body, the lower and inner half of it remaining visible. Very little inflammation followed, and the pupil being kept dilated with belladonna, the eye seemed to be suffering little from the injury, except the impairment of its sight. I did not see him until the 11th July. The lens was then in the position indicated, its lower and inner margin crossing the pupil obliquely near its centre, and the pupil below this being hazy, and having a dull reflex by the OS. The pupil was also drawn downwards and inwards (*i.e.*, in the direction contrary to that which the lens had taken), probably from vitreous humor which had been forced forwards through it on that side at the moment of injury. The anterior chamber was rather large; the cornea slightly hazy; the ciliary vessels somewhat injected. The eye was decidedly too hard, T2. As there was little pain, it was doubtful how long the glaucomatous state had existed. Iridectomy, however, and the extraction of the displaced lens being clearly indicated, both were at once proposed and performed the same day. The iris was excised over the lens, upwards and outwards, and the greater part of the lens easily removed by a scoop. Some vitreous humor was necessarily lost, which was firm and apparently clear.

After this, there was –T for three days, and afterwards Tn until the 25th, when it rose to T1, with a little renewed redness; the sight again less clear than it had become subsequent to the operation. There was no obvious cause for this new increase of tension, and it was treated by rest, atropine lotion, and seclusion of the eye from light.

27th.—Still T1, but less redness, and eye quieter.

Aug. 6th.—Tn; no redness or pain.

Remarks on the Three Foregoing Cases.

In the first, the sudden displacement of the lens and pressure on the iris, so as to force it forwards and drag upon its ciliary attachment; dilating the pupil seemed to give rise to the glaucomatous state, to a redundance of the secretions within the eye, and a heightened tension in consequence. This subsided and recurred several times, in apparent dependence on the same cause. Finally, under a continuance of this displacement, and of the congestion and consequent effusions, the glaucomatous tension gave place spontaneously to the reverse state, viz., a morbid slackness which is not usual in idiopathic glaucoma, but which must be regarded as a phenomenon of the same order as the hardness, only in the reverse direction—a disturbance of the balance of secretion and absorption from certain vessels within the eye. If the one condition, according to the views of Professor Donders, be the result of a reflex irritation of the nerves controlling the secretions, the morbid softness may have been a consequence of this irrritation having passed over into a state of paralysis of the same nerves. Whatever the explanation, the fact is remarkable, not less than the additional fact that iridectomy, with the removal of the lens as the original exciting cause of the whole, put an end to the whole series of morbid phenomena, and restored permanently the healthy state of the vessels, and the proper balance of the tension.

In the second case also (that of the clergyman) the glaucomatous hardness of the eye seemed to originate in the traumatic displacement of the lens and pressure on the iris. It increased as the iris was more pushed forwards towards the cornea; and it was similarly at once relieved by the operation, though the removal of the lens only, with some vitreous humor, sufficed for the result.

In Case 3, the conditions produced by the injury, as well as the remedy, were of corresponding kind.

In neither of these cases of glaucomatous disease, produced by a mechanical cause, was there any tendency to suppuration of the globe, or even to hypopyon, *i.e.*, effusion of pus or lymph into the anterior chamber. In this they correspond with ordinary glaucomatous affections, where effusions are usually serous, rather than fibrinous or purulent. And this has, no doubt, a close and intimate relation with the nature of the morbid process. In iritis, attended by effusion of serum or lymph, and in ordinary hypopyon, augmented tension of the globe is, as a rule, absent. Thus the *type* of glaucomatous disease is different from that of inflammation. It is essentially an altered balance of secretion, in which intra-ocular secretion, even if of only the natural fluids of the eye, is in excess of the normal quantity, and removal by the vessels does not keep pace with the effusions from them. When pus or lymph are poured out into the chambers or tissues of the eye, as a consequence of inflammation, not of the glaucomatous type, the normal fluids, especially the water of the aqueous or vitreous humors are absorbed in a corresponding or even an excessive measure, and the tension of the whole organ remains normal, or may be even slackened. Those who would advance at all towards an understanding of the nature of glaucomatous disease, must acknowledge these facts, for they are fundamental. It seems to be a reasonable corollary from them, that glaucoma is, in its essence, not an inflammation; and when inflammatory, only so, as it were, by accident or complication. It is easy to see how serious such an inflammatory complication must become when affecting the vessels of structures confined by their very anatomical arrangement within the corneo-sclerotic case, the limits of whose normal extensibility have been already reached under the distending influence of excessive production of secreted contents, and which must then necessarily react on the contained tissues with a baneful pressure proportioned to its suddenness and intensity. The acute and penetrating genius of von Graefe has sufficiently shown how this pressure must be most peculiarly exerted on the optic disc, and on the circulation and innervation of the retina.

Leaving the subject of glaucoma, I may add to the details of the first related case, notices of a few others in which a similar defect of the lenses was observed, as they may go to furnish materials for a general account of such faults of development.

Case 4.

August 17th, 1858.—A little boy of five years old had always been noticed to be "short-sighted," but two days ago a peculiar appearance was noticed in the left eye, and he was brought to me accordingly. His parents stated that eighteen months ago he had fallen out of bed on his head, that he had been stunned for five minutes, and been convulsed; moreover, that a year ago, he had run his head against a door.

These facts had been recollected when attention had now been called to the eye, but I could not suppose them material. I found that both lenses were lower than natural, so that when the pupils were moderately dilated, their upper edge crossed a little below the upper margin of the pupil, the right being the lower. "The pupils act well: and whenever the head is held forwards, the left lens falls partially forwards through the pupil and keeps it distended. Even when the head is not in this position both irides are bulged below by the lenses, and they are very tremulous. There is no pain or inflammation."

I took accurate notes of the above condition, and saw the little fellow from time to time. There was occasionally some injection and watering of the eye; and as the extreme mobility of the loose lenses continued, I was apprehensive lest they might not at some time become detached and fall back into the vitreous humor, or at least become dislocated more completely forwards, and occasion serious inflammation, and even loss of the eye, of which I had seen several examples. Accordingly I extracted each lens by a small upper section under chloroform. They were helped out clear in their capsule, by a spoon which I had had made for the purpose, a little vitreous being lost. Recovery in each case was immediate. No iris prolapsed, and none was excised; but afterwards the pupils, though quite clear, were drawn upwards as though after iridectomy, the irides remaining as tremulous as before.

With so young a subject, and an unusually undeveloped mind, it was not possible to ascertain the amount of vision. For objects and colours, however, it was manifestly good.

In April, 1862, he could see J16 at 2″, and was a little helped by glasses. Both Tn. The OS revealed no evidence of disease about the yellow spot, but in the right eye there were doubtful signs of œdema of the retina.

1863. Mind that of a little child much younger. Cannot give his attention to anything. Memory bad. Head large. Doubtful whether glasses of $\frac{1}{6}$ help a little. To try such.

1865. Intelligence growing. Sight certainly not worse; sees objects very fairly, so that a stranger would not at first observe any defect of sight.

In the preceding case the want of cerebral development and the probable feebleness of the retinæ, are interesting in connexion with this failure in the development of the lenses. Congenital cataracts may occur in the same relation.

The following case illustrates how useful such eyes may be, provided the retina be sound and the lenses stationary, not swinging about with the movements of the head or globe.

CASE 5.

T. S., æt. 18, school teacher. Sight as now from childhood; had severe fits with contraction of hands and feet up to two years old; health tolerably good since, but was thought to be consumptive when 12 years old. The head and face are unusually formed, with large overhanging brows and broad alæ nasi. No peculiarity of the teeth; joints of the fingers large. He has read a good deal without difficulty, as, indeed, the nature of the employment which he now follows shows, for he has only applied on account of being "short-sighted," thinking that glasses will relieve him. He has several brothers and sisters all with good sight.

He holds the book very near the eyes, and reads with one eye, the left having slight external strabismus. The pupils are rather dilated and sluggish, the right more so. F normal, Tn.

The right eye could see Snellen 200 at 4′; with $\frac{1}{5}$ 200 at 10′; without a glass, J16 at $2\frac{1}{2}$″; after atropia J10.

The left eye Snellen 100 at 10′; with $\frac{1}{5}$, 100 at 20; without a glass, J1 at $2\frac{1}{2}$″. Convex glasses helped but slightly.

With the OS the lenses are seen in about the upper two-thirds of the pupils, being displaced upwards, as well as too small and false in shape. For the lower margin, instead of being of a regular curve, presents several sinuosities, and takes on the whole a horizontal direction, as though the lowest part had sprung upwards, released from its attachment to the ciliary body, while the lateral parts were still held by the suspensory ligament. It is remarkable, however, that although the lower and, of course, the marginal part of the lens is thus irregular, the nucleus seen in quite the upper part of the pupil is perfectly circular, and therefore unconformable in its outline to the marginal part. Its outline is distinguishable, because it is not, like the margin, quite transparent but faintly opaque, in fact cataractous, though probably only in a very thin lamina of its superfices, and through it as well as through the clearer margin, as also below, where there is no lens the od is easily distinguishable. In both eyes there is the myopic arc—in the right below, in the left outwards.

Remarks.

In this interesting case the lenses were not mobile, being held by the suspensory ligament in rather more than a half of their circumference, and the irides were also not tremulous. Neither was there the risk of dislocation which attends more extensive separation of the suspensory ligament. From the integrity of shape and perfectly circular outline of the nucleus, compared with the irregular margin of the superficial layers of the lens in the lower part, it may be inferred that the partial separation from the ciliary body took place after the formation of the nucleus, though this was slightly opaque, but before that of the superficial layers, though, as in juvenile cataracts, these were transparent.

The following case, imperfectly noted, was observed in 1855 :—

Case 6.

A young gentleman, æt. 15. Very "short-sighted." When he reads the paper touches his nose. Pupils both active and clear. Irides dark brown, both very loose and floating. Concave glasses diminish objects and do not enable him to read further off, or to see better at a distance. The pupils do not alter in size when he looks in the same light from a near to a distant object, or *vice versa.* His sight at a distance is such that he can count fingers at 30 feet.

The eyes are strong for work and never tire. He never sees false colours, or muscæ. He sees alike in strong light and in dusk. The *right* eye has the worst sight and cannot read ordinary type.

The right eye was examined under atropia. The lens was seen perfectly clear but rather small, and displaced downwards and outwards, so that its upper edge crossed the dilated pupil obliquely, about one-third from the top. The precise displacement of the left lens was not recorded.

The following cases exhibit a marked family tendency to imperfection of the eyes, of which one example at least is small and displaced lenses, ending in absolute glaucoma.

Case 7.

Mrs. M., between 60 and 70, has been totally blind in one eye twenty years, in the other fifteen years, both probably from acute glaucoma, according to the history.

Case 8.

Mr. M., æt. 43 (son of Case 7). Has always had imperfect sight. Both lenses have delicately-traced opacities on the front, those of the right being the fainter, those of the left the denser, but with clear interspaces. As his sight was stationary for many years, these opacities have probably existed from an early age. Lately he thinks the sight has been worse. He uses the right eye for reading, and the left for distant objects, using a concave glass of $\frac{1}{20}$. Lately the eyes redden on use.

There is insufficiency of the int. recti on looking at near objects, the left eye then moving outwards. As he managed to pursue his avocations no operation was recommended, though such may become necessary. Being found to read more comfortably with a convex glass of $\frac{1}{30}$ and prisms of 3°, these were ordered with an eye-douche.

Case 9.

Mrs. C., æt. 38 (daughter of Case 7). Sight always imperfect, and has used atropia for many years. Without atropia, J18; with atropia, J7 and 8. Both eyes present good examples of juvenile nuclear cataracts, the superficial layers of the lenses being clear. She has always read with comfort, but applies now because the atropia has lately irritated her. Another form was ordered, with an intimation that an operation for displacing the pupil would be applicable in case of the belladonna still being unmanageable. For three years I have not heard of her, so I conclude it succeeds.

Case 10.

Miss M., æt. 33 (daughter of Case 7). Absolute glaucoma of both eyes. Both T1. The right has a singular abrupt and prominent ciliary staphyloma upwards and inwards the size of half a pea. She was "very short-sighted" as a girl, but could see small objects well with the right eye if they were held very near to it. The right gradually failed twelve years ago; the left also gradually six years ago. No perception of light for three years.

The pupils are widely dilated. Both lenses are clear and are displaced upwards and inwards so much that only one-fourth of each is visible in the large pupil. The fundus of the eyes lights up well, there is slight glaucomatous cup in each, and the retinal vessels are atrophied. The loss of sight seems to have been due to simple glaucoma of the ordinary kind.

Remarks on the Last Four Cases.

They illustrate a fact I have often noticed, viz., that a family tendency to defect or disease in the complex organs of sight, though often manifesting itself in even the exactest identity of form, yet may do so in other cases with variations, as here; *a*, displaced but clear lenses; *b*, rather peculiar form of early cataract; *c*, the more common form of nuclear juvenile cataract; *d*, glaucomatous affection; the latter being the most subtle, and referrible perhaps to some inherited disposition of the vessels or nerves which may be supposed to be the primary seat of that disease. It may, however, be added that I have noticed a decided tendency to glaucomatous disease in persons who have undergone, *late in life*, an operation for juvenile cataract —the same operation which at an earlier period would have been perfectly well borne, inducing in them an intractable glaucomatous reaction, and constituting one of several valid grounds for not too long delaying operative relief. I have attributed this to the long strain to which such eyes have been exposed in looking always through the dull medium—a strain alike of the retina, of the ciliary apparatus, and of the external muscles, and manifested often by redness, watering, and distress. But yet glaucoma, independently of this, is often decidedly hereditary, or a family complaint.

XXII.

OPHTHALMIC MISCELLANIES.

By William Bowman, *F.R.S.*, *in 'Ophthalmic Hospital Reports,'* 1869, *Vol. VI*, *pp.* 1–11.

No. II.—CASES OF ZOSTER, OR UNILATERAL CONFLUENT HERPES OF THE OPHTHALMIC REGION.

(For abbreviations used in this paper see *antea*, p. 361.)

Cases of this nature have attracted my attention during many past years. The following extracts, drawn up by Mr. Rogers, from my Case Books, are offered for the additional light they may throw on the clinical history of an affection not very much known. In connexion with them I must refer to a graphic description in the clinical lectures of Trousseau ("Clinique Medicale," 2nd edit., t. i, pp. 192-8), and to an excellent paper by Mr. Hutchinson in the 'Ophthalmic Hospital Reports,' Vol. V, p. 191.

I have frequently seen this disease mistakenly called "erysipelas" even by accomplished practitioners. From this it is distinguished by the pain preceding the eruption, by the mingled numbness, pain, and heightened sensibility remaining for a long period after the inflammatory outburst and especially by its not overpassing the median line. As the nerves of sensation certainly play an important part in zoster, and the fifth is an eminent example of this system of nerves, its distribution special, and accurately known, the local form we are now considering is of peculiar interest, furnishing probably the one example wherein its very remarkable features may be most advantageously studied.

Zoster seems to be a peripheral disease, having its primary seat in branches of the nerves of common sensation. Probably these nerves, often from cold, become inflamed in the more superficial portion of their trunks, and in their distribution up to their ultimate network, hereupon the eruption succeeds as the result of an extension of vascular excitement to the cutaneous tissues anatomically related to this network. This view enables us to understand the pain and tenderness present in the part (usually for some days) before the skin reddens or the clusters of vesicles appear. It may explain the long continued, sometimes lasting alteration of sensibility in the whole region of the distribution of the affected nerve-branch, even in parts where the actual eruption may have failed to appear.

That peripheral excitement of sensitive nerves originating in a central or reflected source may induce tenderness and redness in the region of such nerves is sufficiently well known. In ophthalmic practice it is common, when an eye is intensely affected with inflammatory pain, especially if with intra-ocular tension the ciliary nerves are compressed or stretched, to have the whole of the same side of the head, even to the occiput—sometimes the opposite side in a less degree—not only the seat of acutest pain, but also highly sensitive to the touch, such tenderness only gradually subsiding after its cause has been relieved by (perhaps) iridectomy for glaucoma, or by excision of the globe. I have not seen zosteric eruption thus induced, but there is an evident analogy between the two states.

Parts of the Eye affected.

It is not always possible to examine the eye accurately during the herpetic attack owing to the swelling of the lids; but when this subsides it is usually easy to ascertain what tissues have suffered. I have seen nothing like herpetic eruption on the conjunctival surface of the lids or globe. The conjunctiva may be too red, the eye may be watery and intolerant of light, and the peculiar pain of the affection may be experienced in, or referred to, the organ itself; but usually there is no primary disease, such as corneal or iritic inflammation, coincident with, or forming a part of, the eruptive stage of the complaint. If these occur they seem rather to follow after a short interval. Small softenings or ulcerations of the cornea, rather marginal than central, and slight iritis are the more common complications but rather the former than the latter, andthey have seemed to me to bear considerable resemblance to those following small-pox both in their course and the treatment they demand. This should be of a soothing or supporting kind, the lids being kept closed, and time being patiently allowed for the necessarily slow process of healing under natural influences. I have not found affections of the eye-ball to occur specially in those cases of ophthalmic zoster in which the eruption followed the course of the nasal branch.

Treatment of the After-pains.

I wish I could state anything very satisfactory as to the treatment of the after-pains, which are sometimes so severe as to make the patient weary of existence.

In Case 4, subcutaneous division of the nerve was only undertaken after almost all other remedies, local and general, had failed. It certainly for a time took away all feeling from the region to which the frontal nerve is distributed; and when touched in this region, the patient no longer experienced the pains which previously tormented him. But in a few weeks the sensibility had returned, and even at first the pains in the neighbouring parts to which the remedy had not extended, seemed such as to make the partial relief very little appreciated. It may be also that the morbid condition of the nerve on which the pain depended was not confined to the part peripherad of the point of section, and that the central portion continued the seat of pain. Perhaps if it had been possible to divide the nerve further back, the relief would have been greater.

In Case 6, very marked relief did follow section of the nerve, and with clear evidence of the fact. When the frontal nerve was divided, the frontal pain was greatly lessened. When the external nasal branch was cut, pain was no longer referred to the skin of the nose, while the inner surface of the nostril continued to be the seat of distressing pain, and I could think of no way of dividing the inner branch entering the nostril far back through the ethmoid. The relief, so far as it extended, was in this case so permanent and considerable as constantly to elicit the patient's thanks. The result in this single case would incline me to recommend the division of the nerve, a very harmless proceeding under chloroform whenever the after-pains are severe and continuous in spite of time and other treatment.

Trousseau says, *op. cit.*, p. 197, "I have known an old lady, who at 70, had shingles, and who, for fourteen years afterwards still suffered the most terrible pain, especially at night. Now I have under treatment a lady of 60, who for five years has been terribly tormented by the pain of herpes. I have noticed several times a singular phenomenon: the simple contact of the clothing often provokes the most unspeakable torture, and yet the skin has superficially a kind of insensibility which lasts often long after the pains have ceased." Surely when the nerve of such parts can be reached, it must be worth while to annul its function by cutting it across.

Case 1.—Herpes r. Forehead, with Nebulous Cornea.

Oct., 1855.—Miss B., aged 40, had had herpes on the right side of the forehead in the previous June, attended with ophthalmia of the right eye, dimness of the cornea, and severe pain of a rheumatico-neuralgic character. The affection was attributed to exposure to cold winds. When seen the right cornea was nebulous, with a streak of lead deposit in the centre.

Case 2.—Herpes r. Forehead, with Nebulous Cornea and Iritis.

July, 1856.—Miss W., aged 57, had suffered for three years from severe inflammation of the right eye, which had left a slightly nebulous cornea. She had muscæ, flashes, and periods of temporary blindness.

She was not seen again until April, 1866, when she brought a history of confluent unilateral herpes of the right side of the forehead, in 1860, of which large scars remain. She had suffered from neuralgia of the right side of the head, eye-brow, lids, and in the eye, since the attack of shingles.

The right eye was T1, there was a dense buff nebula occupying nearly the outer half of the cornea; there were numerous adhesions of the iris to the capsule of the lens, lens clear or nearly so, Pr $\frac{1}{10}$ and Hm $\frac{1}{16}$. She could read J8 with $\frac{1}{10}$ and with $\frac{1}{16}$, Snellen 70, at 10′. She had used convex glasses for thirty years. Left eye Tn, posterior synechia, pupil almost closed, no reflex from the fundus, only perception of light.

Case 3.—Herpes l. Forehead with Int. Strabismus of l. and Diplopia.

Mr. W., aged 36, was seen in March, 1858. He had had a consumptive tendency for three years. On two occasions the diplopia had occurred for six weeks and then ceased. At this time he had diplopia of four months' duration, following an attack of "erysipelas" (shingles), which had left cicatrices on the left brow, and a sensitive state of the skin. Diplopia horizontal, right image formed by right eye, and faint, the two images a foot apart at 12′. Giddiness with each eye constant. The eyes appeared straight, but the left had a slight tendency to internal strabismus, on looking to the right.

March 18th, 1859.—Soreness and numbness of the skin have continued. The diplopia has increased, and there is decided internal strabismus. He always walks with one eye closed on account of the double vision.

Division of internal rectus was suggested, but not acceded to.

Case 4.—Herpes l. Forehead and Scalp with Conjunctivitis. Division of Supra-orbital Nerve.

Mr. L., aged 70, was first seen in May, 1862, when he had some dimness of the left eye, caused by faint striæ in the lens.

On Nov. 7th, 1865, he came again with the following history sent by his medical man. In the previous July he had one day intense pain in the right eye and forehead, followed on the next day by a spot of herpes in the centre of the forehead. In a day or two the inflammation spread to the neighbouring skin, and soon advanced over the entire half of the scalp. The disease was considered a combination of herpes and erysipelas. Blisters formed wherever the mischief wandered, and the whole of the right half of the scalp was raised by a bluish sanious fluid. Under a liberal diet, wine and quinine, he slowly recovered. As the eruption disappeared the skin was found numbed and hardly sensitive to the touch, but this condition was soon succeeded by extreme hyperæsthesia, and very intense neuralgic pain. As convalescence advanced, the conjunctiva of the right eye became inflamed. He had in October an attack of gout, which for the time gave relief to the eye. On his visit in November, the skin on the side of his forehead and vertex was extremely sensitive to the touch, cold, heat, &c., and he had almost constant neuralgic pain. The cornea was clear, and the conjunctiva hardly affected. The forehead was covered with scars.

Embrocations and hypodermic injections caused no relief, but some ease was given by wearing a cap of cotton wool.

May 9th, 1866.—Still constant pain. Sleeps badly, and does not bear opiates. Sensitiveness of skin very great. 16th. Supra-orbital nerve divided sub-cutaneously as it emerges from the orbit. There was hardly any external bleeding. 17th. Considerable ecchymosis of the upper lid, good night, without neuralgia. 19th. Still pain in side of temple and nose, but expresses himself relieved since the operation. The last account received in December reported very little improvement, as resulting from the operation.

Case 5.—Herpes l. Cheek and Temporal Region, with Atrophy of the Optic Nerve.

May, 1864.—Mr. D., aged 44, was attacked in January last with inflammation of the side of his face, which was considered as erysipelas. It occupied the left half of the face as far down as the level of the lobe of the ear, but not the ear itself, nor the nose, except about the bridge. It extended also to the left temporal region, and for a short distance above the brow—nowhere else. In ten days it had reached its worst, and for three weeks he was very ill, with much swelling of the left lids, and great pain. When the swelling subsided, the left eye was found to be blind. At the end of five weeks, when the face was well, the right knee became much inflamed and swollen—it is now 2½ inches more than its fellow in circumference, and has been in a plaster of Paris bandage for six weeks.

Now, left upper lid tumid, and half open. Movements of the globe normal—no paralysis of the third nerve; left globe, Tn, pupil dilated, and acts only with the right retina, no perception of light; OS clear, od white, arteries and veins small.

Right eye perfectly good. Sensation perfect on skin everywhere.

CASE 6.—HERPES L. SIDE OF HEAD, CHEEK, NOSE AND LIDS, WITH NEBULOUS CORNEA. DIVISION OF SUPRA-ORBITAL AND INFRA-TROCHLEAR NERVES.

SAMUEL H., aged 55, a sailor, came to Moorfields in May, 1866. The right eye had been blind 18 years. Sight failed gradually during a voyage to Hobart Town, without pain or inflammation. Tn. OS atrophy of the optic nerve. In November, 1864, he was seized with violent pain shooting through the head, followed by inflammation of the left side of the head, with swelling and great pain of the left brow and cheek. It was said to be erysipelas. He was in the hospital at Point de Galle, Ceylon, for twelve months, the inflammation lasting for about five months. Ever since, he had had a numb feeling of the left side of the head, cheek, and side of nose, with great soreness to touch—hyperæsthesia—could not bear a brush to his hair. He had frequent darting, shooting pains in the left temple and side of the head. There were white scars, not deep, but well marked, on the skin of the left forehead, on the side of the nose, and on the upper and lower lids. The palpebral conjunctiva had cicatrices from old granulations. Cornea, nebulous on the lower part, and facetted about the apex. Tn. J16.

Mr. BOWMAN passed a broad cutting needle under the skin above the left brow, and divided the supra-orbital nerve. A compress was applied, and there was hardly any bleeding. The operation was followed by relief from the extreme sensitiveness of the skin of the forehead, but the pain in the vertex and side of the nose continued. A fortnight afterwards, the branches of the infra-trochlear nerve were divided, and also an artificial pupil made outwards in the left eye. The pain in the skin of the nose was relieved at once, and in a few days he left the hospital.

Sept. 28th.—He has continued free from pain in the temple and side of the nose, and the pain of the vertex is much lessened. The inner surface of the left nostril is extremely sensitive to the touch, and often gives him a good deal of pain. Vision generally improved by the artificial pupil.

Nov. 13th.—There is now no pain in the vertex, nor on the outside of the nose, but the inner surface continues very sensitive. He is looking greatly improved in health. He can see J12. As he is hypermetropic $\frac{1}{24}$, he wears a glass of that power, and is enabled to get about and do a little work at the Sailors' Home, of which he is an inmate.

CASE 7.—HERPES R. FOREHEAD WITH NEBULOUS CORNEA.

July, 1866.—Miss S., aged 60, had two years ago severe pain over the region of the first division of the fifth nerve, followed by confluent herpes of the forehead. She suffered extremely for three or four weeks, but was somewhat relieved by blisters behind the ears. Numbness and hyperæsthesia of the skin have remained ever since to the present time. There are patches of cicatrix above the brow, and an uneven nebulous state of the upper part of the cornea. She has frequent attacks of neuralgia also, on the right side of the head.

CASE 8.—HERPES R. FOREHEAD AND INFRA-ORBITAL REGION WITH IRITIS AND ULCER OF CORNEA.

Oct., 1866.—Mrs. S., aged 52, came on October 27th with the following history, kindly given by Mr. KELSON WRIGHT, her medical attendant.

On Sept. 28th she had been seized with severe pain over the right brow (like clavis hystericus), accompanied with lacrymation and photophobia.

On the fourth day after October 2nd, several patches of herpes appeared between the right brow and the root of the hair, extending to the median line in one direction, and to the middle of the temple in the other.

On the 4th, a zonular redness was noticed round the cornea. The pain over the brow was very severe.

On the 6th there was great photophobia, and the pupil was seen to be irregular.

By the 12th the patches of herpes were nearly well, but the pain continued, being much aggravated at night.

On the 20th the cornea appeared rough and hazy, sight was much impaired. The burning, stinging pain in the brow continued.

On the 27th, when Mr. BOWMAN first saw her, the eye was less inflamed, but the photophobia and pain remained. The cornea was clear, but at the inner and lower margin, for about a quarter of the circumference, there was an abrupt, deepish ulcer. The pupil, under atropine, showed several adhesions of the iris to the capsule of the lens. The conjunctiva was a good deal injected. Tn. There were marks of the herpetic eruption over the right forehead, and a small patch over the infra-orbital foramen; none on the nose. The skin of the forehead was very painful and tender to the touch, and the patient had been suffering severely from neuralgia, especially at night, so much so that she had hardly had a night's rest during the month. She stated that she was liable to free perspiration, and attributed the attack to exposure to cold wind during a profuse perspiration. A hypodermic injection of morphia was employed that evening, after which she slept well, and continued free from pain the following day.

On the 29th the pain returned, but to a less degree.

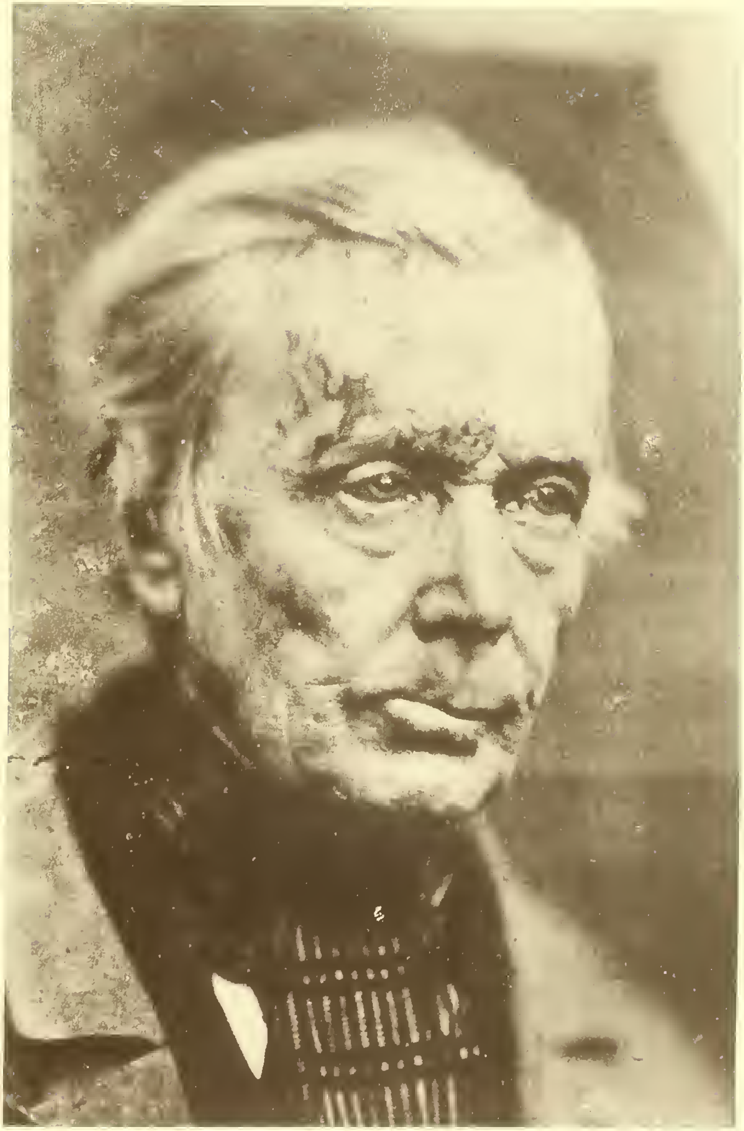
At the latest report (Dec. 21st) the cornea was quite clear, no trace of ulceration remained. The only complaint was of irritation when warm, or near the fire, in the spots where the eruption had been; and the skin continued of a dark colour, but free from scars.

CASE 9.—HERPES R. FOREHEAD AND EYELID; GLOBE NOT IMPLICATED.

EDWARD H., aged 70, was seen in December, 1866, when he stated that five weeks previously he had severe pain on the right side of the head, followed in a fortnight by an eruption over the corresponding side of the forehead. This was accompanied by tingling and numbness of the skin. These symptoms increased for about three days. The right lids were a good deal swollen, and the sight a little dim. His general health was very good. At the time of his visit the eruption had disappeared, but dark brownish scars remained, occupying the right side of the forehead, temple, and upper eyelid. The great force of the herpetic attack seemed to have been expended at the commencement of the frontal nerve, where the scars were deeper and darker, and it seemed to have diminished in violence as it followed the distribution of the nerve. The eruption was limited accurately by the middle line of the forehead, and spread upwards amongst the hair to about the fronto-parietal suture, and laterally over the temple. The skin was numb to the touch, and at times, especially at night, the seat of tingling and smarting relieved by the application of warmth. The pain had not been very violent, except at the outset of the attack. The right side of the nose also was numb, although there had not been any eruption on it. The sensation of the rest of the face was normal. His vision was unaffected.

Feb., 1867.—Numbness continues, and tingling at times at night now aggravated by heat. Slight tinea of upper lid.

This case is illustrated by the annexed photograph, taken by Mr. ERNEST EDWARDS about six weeks after the attack.



XXIII.

CASES OF TEMPORARY ANCHYLOBLEPHARON.

Reported from the Practice of Mr. Bowman, *by* Mr. C. J. Workman, *in* '*The Ophthalmic Hospital Reports*,' 1871, *Vol. VII*, *pp.* 1–5.

It is well known that, from the little resistance that the eyelids offer to any contraction of the skin in their neighbourhood during the process of cicatrisation, the upper or lower lid is not unfrequently displaced and its mucous lining everted. This is not only an annoyance to a patient but is also a source of danger to the eye when the ectropion is so severe that the lids cannot be closed. To the surgeon it has been a matter of difficulty to remedy such a deformity. In the first of the cases recorded below, Mr. Bowman conceived the idea that, if after releasing the tissues, he were to unite the upper and lower lids for a time, he would obtain a better effect than by simply performing a plastic operation. The result fully realized his anticipations, as the band of union between the two lids prevented to a great extent the upper one being drawn up again, while the tissues were cicatrising at the site of the plastic operation.

The success of this proceeding has led to its being adopted in another class of cases—that of palsy of the seventh nerve, where the patient is unable to close the eye, which in consequence suffers from constant exposure. Here, too, the result has been very satisfactory.

Amy R., æt. 17, came to the Royal London Ophthalmic Hospital, in 1863, with a fistulous opening beneath the left eyebrow at the inner side. This Mr. Bowman found was connected with diseased bone, and he succeeded in removing two pieces of the ethmoid bone.

In November, 1865, she came again to the Hospital. The sinus had healed, and the cicatrix had so drawn upon the skin of the upper lid, that the inner third was everted, and the girl was unable to close the eye. Mr. Bowman performed a plastic operation, to release the skin in the neighbourhood of the cicatrix, and united the two lids near the middle of their margins for about $1\frac{1}{2}'''$. (Diagram 1.)

In November, 1866, she was re-admitted into the Hospital. The lids were firmly united by a band of skin, which divided the palpebral fissure into two parts; she was able to open the eye sufficiently to look out of each aperture. The tissues at the site of the old osseous disease were much laxer; another operation was now done, bringing the tarsal margin of the inner upraised one-third portion of the upper eyelid to the level of the outer two-thirds, but the band of adhesion to the lower lid was untouched. (Diagram 2.)

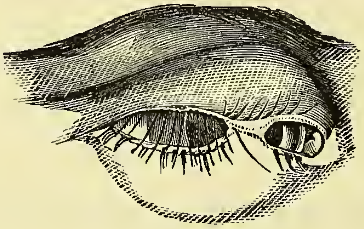


DIAGRAM 1.

In February, 1867, Mr. Bowman divided the connexion between the two lids, and at the same time did a further VY operation, in order to bring the tarsal margin to a lower level.

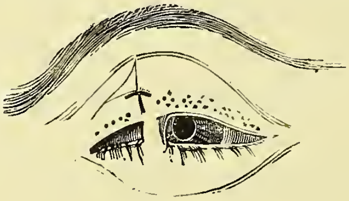


DIAGRAM 2.

At the end of April the patient came to show herself; her appearance had much improved, and there had been but very slight contraction of the tissues, so that on closing the eye there was but a very small chink between the lids.

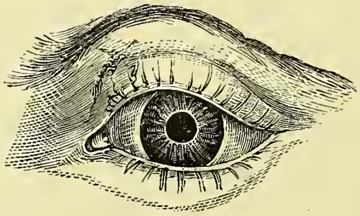


DIAGRAM 3.

She was able to read Jäger 4 with this eye, the cornea of which was slightly nebulous, from an attack of inflammation when she was three years old. (Diagram 3.)

In December she came into the Hospital for a few days, when it was found that she could close the lids quite as well, if not better than in April, the tissues around not having contracted again since the union between the lids had been divided.

In the following case the cornea had commenced to ulcerate from being constantly exposed, but recovered after the lids were united.

The case has an additional interest, as there can be little doubt but that the optic nerve was divided by the splinter of wood.

Valencia W., æt. 5, came to the Royal London Ophthalmic Hospital, on October 29th, 1867, with an orbital abscess following an accident. Her father stated that, a short time before, she fell down, striking the right eyelid against a hoop stick. The child was placed under chloroform, and Mr. Bowman made an incision beneath the brow; the exciting cause of the abscess was found to be a piece of wood, which had become embedded in the orbit.

In June, 1868, the following was the patient's condition:—There was an unsound cicatrix below the right brow, and the upper lid was drawn up, so that the eye could not be closed. The globe itself was injected and pushed forwards, and a little downwards. On the cornea was an ulcer to the inner side of the pupil, and this was accompanied by onyx. To prevent any more retraction of the upper lid, and also to protect the cornea, Mr. Bowman pared the edges of the lids about the middle, for about an eighth of an inch, and united them by two stitches; before doing this he made an incision along the site of the cicatrix, so as to release the skin a little, and also to examine with a probe whether there was any more wood or dead bone; but nothing was removed.

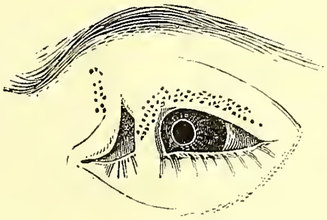


DIAGRAM 4.

At the end of June, ten days after the operation, the lids were firmly united, and the upper one already elongated. There was a good deal of discharge from the opening below the brow.

April 9th, 1869, she was brought to the Hospital to be seen, before her father and his family went to Chicago. The sinus which had existed had closed some six or eight weeks, but the tissues did not seem thoroughly sound. The lids were united by a band, as seen in Diagram 4.

The child could not perfectly close the eye, but this had recovered as far as the ulcer of the cornea was concerned, a slight opacity being the only trace left. She has never had any perception of light since the accident, and it seems probable that the splinter of wood had divided the optic nerve. With the ophthalmoscope the nerve was seen to be completely atrophied.

Mr. Bowman thought it advisable to postpone the division of the band, as the cicatrix at the site of the necrosis was not yet sound, and there was a chance that the lid might be displaced again.

The next case is an illustration of the advantage derived from uniting the lids in a case of paralysis of the portio dura, and by this means preserving the eye from irritation during recovery.

In May last, Mr. Lawson united the lids in a woman at the Hospital who was suffering from facial palsy and paralysis of the orbicularis. In consequence of not being able to close the eye, it had become inflamed, and caused the patient a good deal of annoyance. In two months' time she had recovered a good deal of power in the orbicularis, though the facial palsy persisted. The general condition of the eye had much improved, and the patient said that the operation had been a great comfort to her. As she could now nearly close the eye herself, Mr. Lawson divided the band of union.

The illustrative woodcuts, Nos. 3 and 4, were kindly made by Mr. Fairlie Clarke.

NOTE BY MR. BOWMAN.

(In this operation of uniting the eyelids for a temporary object, care must be taken not to interfere with the subsequent integrity of the tissues at the tarsal margin. If delicately done, it will be found sufficient to shave off a very thin slice of the opposed margins along the line of the Meibomian orifices, not including that of the cilia. Very fine threads should be used, and should extend beyond the bare surfaces, and take a good hold of the edge of the lid, so as not to cut themselves out. They should be removed on the fifth to the eighth day.)

XXIV.

OBSERVATIONS ON VARIOUS PRACTICAL POINTS OF OPHTHALMOLOGY.

By Mr. Bowman, *3rd August*, 1872. *Reprinted from 'Report of the Fourth International Ophthalmological Congress,' pp.* 177 *to* 183.

I am unwilling that the Congress should assemble in London without having an opportunity of saying a few words, and, if the President will allow me, I will advert to a few points of practice in the order in which they occur to me.

Enlargement of the Pupil by Incision of the Pupillary Fibres from behind forwards.

There is, first, an operation which has some novelty in the manner in which it is performed—an operation for artificial pupil, or for enlarging the pupil. We all know that it is exceedingly important, in certain cases, to make the pupil in one particular part, and to limit it precisely as far as possible. In cases of lamellar cataract, for example, in which the cataract is very small, and in which there is a considerable marginal part of the lens quite clear, the operation for enlarging the pupil outwards, so as to allow the light to pass through this clear portion, is one that has been performed in various ways, which I need not enumerate. I will merely state that it occurred to me in one case of conical cornea, in which the lens was clear, to operate by a method which, so far as I know, is novel. I had previously done a double iridodesis. The resulting vertical pupil, when the light met the eye, was simply and absolutely linear, and, on looking at the eye at very little distance, the iris only could be seen, with no pupil at all. If the patient turned away from the light, it opened out into a slightly elliptical form. The conicity remained, with such an amount of sight as the conicity through this imperfect pupil would allow. I had performed the double iridodesis several years ago, when I first proposed to apply Mr. Critchett's operation to cases of conical cornea. This patient came up last year, and I then saw the desirableness of operating on the apex of the cornea according to the method proposed by von Graefe. I operated, and after a time I got a slight reduction of the apex of the cone, but there remained the perfectly linear and exceedingly restricted pupil, and it was desirable to open that. I did not know how to effect this, but it occurred to me that I might do it in this way:—I took one of these ordinary canalicular knives, with a blunt point and cutting edge, and having previously prepared a way by a broad needle, I introduced it, penetrating the chamber as far as the pupil, then through the pupil, at right angles to it, and turning the edge forward, cut the iris to the extent desired, in withdrawing the knife, against the cornea, the aqueous having then escaped. The result was a very satisfactory pupil.

Then it occurred to me that this method might also be adapted to cases of nuclear cataract, and I have had a little knife made. I do not know whether it is better than the original one. I think a more delicate one might be made. I have used it in precisely the same way, introducing it through an opening made in the horizontal meridian. I presume it will usually be in that direction that the knife will be introduced, although it might be introduced in any direction, according to circumstances. I have an opportunity of showing to-day a little boy on whom I performed the operation last Monday week. No irritation followed in either eye, and in both a fair pupil has resulted. The nuclear cataract is rather small; the margin of the lens is perfectly transparent, and the pupil is somewhat pear-shaped. The circular muscle of the pupil, being simply divided at one point, still acts a good deal in the rest of its extent, and keeps the central part of the pupil small. His vision is, of course, greatly improved, being the same as before, under atropine. He is myopic to about one-eighth, and that being corrected, his vision amounts to one-half for distant objects. He can read No. 1 Jäger with each eye at fair distance.

I may state that in cutting the iris forwards against the cornea, I not only cut the iris, but I slightly nicked the cornea. There is resulting a very faint opacity where the edge of the knife cut it. I do not, however, think it is of the slightest importance, and it will probably disappear.* I do not think there is any fear that in such an operation the knife would be drawn with such force against the cornea as to penetrate it, or inflict a permanent scar.

I shall say nothing about the advantages of a pupil in that situation, except that it is, of course, desirable to keep it from the margin of the cornea, and as central as we can. I do not intend to recommend this operation in all cases, but merely tell you what I have done under such circumstances as I have related.

Excision of the Pupillary Structures.

There is a mode of operating, which I am not aware has ever been published, in cases in which we wish to cut away the central structures in the pupil, dense false membranes, &c., or when we wish to extract a cataract where there is a membrane on the capsule, and when it is desirable to avoid that upward traction of the pupil towards the section which is apt to occur when such false membranes exist. The inflammation following the operation is apt to occasion new deposits on the old, with so much retraction afterwards, that eventually we find the pupil closed and at the margin of the cornea. Where that may be anticipated, I introduce the ordinary iridectomy knife, running its point through the iris into the surface of the lens. Then I introduce the sharp point of a little pair of scissors through the opening made in the iris, and the blunt point of the other blade in front of the iris and behind the cornea, on one side of the pupil, and then, bringing them together, I divide everything between them. The same thing is done at the other side of the pupil. These two incisions meet at their apex. Then this portion of the iris, including all the pupil, is withdrawn by forceps, and, we suppose, also with it some of the lenticular substance. Then the cataract comes away, and we have only the posterior capsule and a marginal part of the iris left. The future chance of such a patient getting good sight from a single operation is better than if such a proceeding had not been done. I have done this for several years, and occasionally the result has been very satisfactory.

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* 5th April, 1886. Lenses just as before. No opacity of cornea. Myopia right $\frac{1}{3\frac{1}{2}}$, left $\frac{1}{4}$. Each eye reads No. 1 Jäger.

That led me to treat in a somewhat similar fashion the cases in which there is a dense false membrane after iritis (the lens, perhaps, having to be removed), which with great difficulty yields to the knife. It is rather desirable to get it away by cutting round it with scissors. We may take up a triangular portion in the same way, but in order to get away as large a portion as possible I have followed another plan, either with two triangular knives or with a stop iridectomy knife, the stop being near the base, so as to check its advance beyond a certain point. With one of these in one hand, and an ordinary knife in the other, we make a double opening simultaneously on opposite sides of the cornea. It is more convenient, of course, to make these two openings on opposite sides of the cornea in a horizontal than in a vertical direction. I then run a pair of scissors in two diverging lines from each incision, in the same way as before, thus enclosing between the incisions a large square or rhomboidal portion of the irideal region, including the pupil, and all the structures there. You then withdraw the portion thus cut out. There is no drag on the ciliary region; whatever is withdrawn has been cut away from its connexions beforehand.

In these cases we are often obliged to operate with a very small chance of success. In many, the false membrane forms again in front of the vitreous humor. Still we have done what we can, and in a certain number of such cases we have a satisfactory result.

This stop iridectomy knife I have used for cases of glaucoma. We are all inclined in certain cases to make as large an iridectomy as we can. It is possible to remove the whole iris. I have done it myself several times, and I think it not a bad operation sometimes. The method I usually pursue in glaucoma is to introduce the forceps at each angle of the incision, and to seize the iris beyond its limits so as to make a larger iridectomy than incision. Even so it is sometimes desirable, it seems to me, in order to obtain the fullest effect, to make a double iridectomy on the two sides at once. I do not know whether GRAEFE was the first to do so, but all, I suppose, have made a second iridectomy on the recurrence of glaucomatous symptoms in an eye in which iridectomy has succeeded for a time only. It occurred to me that when you anticipate that the glaucomatous state will probably return after an interval we might, by a single operation, avoid the necessity of a second, by taking out at once a piece of iris on the opposite side, in the direction of any diameter selected. But there was a difficulty. The difficulty was, having made the first iridectomy, and the aqueous having escaped, in introducing the knife on the opposite side without wounding the lens. It occurred to me that we might, by using two separate knives at the same moment, before the aqueous escapes, avoid the difficulty. I have often done so, and am not aware that I have ever wounded the lens. The stop knife is introduced first, and then the ordinary knife. While the eye is held by the stop knife sufficiently firm, the other is introduced. It is only necessary to keep the attention directed to the points of the two knives at the same moment, and to keep the points a little forwards while entering.

Conical Cornea.

This is the day of operations on the apex of the cone. It is not long since the operation was always on the iris, and we did not venture to deal with the apex of the cone. When I heard of VON GRAEFE's method of operating on the apex, I performed it in some cases, and with some degree of satisfactory result as regards the diminution of the conicity and increase of vision, but it appeared to me that the application of caustic was attended with a good deal of irritation, continued and repeated irritation, lasting for two or three months in some cases, and it was a distressing process for the patient and for the surgeon. Another inconvenience that seemed to me to attend it was that we had not, by that method, the means that we might wish for of limiting the area of the operation. I think this is a very important point; it is very desirable in various cases, although it is perhaps somewhat a matter of guess how much in any one case we should remove. I do not at all despair of arriving at a time when we may form a pretty exact estimate, according to the amount of conicity, of the quantity of cornea that should be removed, and thus we may be more easily able to treat the cases by a single operation. At present, it is somewhat guesswork as to how much we should remove, and we may have to repeat the operation. It has struck me that the best instrument to use would be something in the nature of a trephine. As it seemed desirable not to entirely penetrate the cornea, it seemed necessary to limit the depth to which the cutting circle should go. I had some instruments constructed by Messrs. WEISS, some with a stop on the outside of the circle, some on the inside. I think that on the inside is much the better. Here is one that moves so that the stop can be screwed up to the cutting edge. Here are three forms. The size of the circle made is determined, of course, by the diameter of the instrument which is used. I soon found that it was desirable to go completely into the chamber and remove, as far as I could, the thickness of the cornea. I think it is a new doctrine to most that it is not so very easy to maintain a corneal opening. It has a great tendency to close. I used some of these instruments in cases in which I wished to establish a temporary fistula. I found that the opening at the end of a few days or a week closed up, if not within that time, with cicatricial tissue, at any rate with thick lymph, which prevented the exit of the aqueous humor, and no doubt that lymph, passing from the margin, eventually closed the opening. In one case particularly (I think it was of serpiginous ulcer of the margin of the cornea), in which every kind of treatment, including carbolic acid, failed to save the eye, I tried for several weeks to maintain an opening, and I failed. It ended by always closing. So I think we may say there is a great tendency in corneal wounds to close. This may encourage us to deal with the apex of the cornea by complete removal of a portion of the tissue. I have never seen an eye lost by it, and this could hardly be, unless too large a portion was removed, so that the corneal tissue was quite insufficient to come together. I think we need not fear that the corneal wound will not unite. I have used these instruments for the apex of the cornea, and with this result: that exceedingly little irritation occurs, and in a very short time, apparently by the contraction of the corneal tissues towards the central wound, the area made by the instrument contracts, and is closed within a week, or at most a fortnight. It has not been necessary to use a suture. In all cases where a considerable portion has been removed, the iris has come forwards and has united itself to some part of the cornea, even where the wound was made in this way, but it is only necessary then, the wound being united, to introduce a needle, and tear through the adhesion. In one case I made an iridectomy at the time of the operation, making it impossible for the iris to come in contact. That had a very good effect, but still I think I shall be rather loth to make an iridectomy, because it will tend to lessen the acuteness of vision.*

I should mention—and I take great pleasure in doing so—that at Moorfields, on Tuesday, our colleague, Dr. DE WECKER, put into my hands a little instrument which is very similar to my trephines. I would have preferred that he had mentioned it to the Congress, but he requested me to do so. It is provided with a spring, by which an instantaneous rotation is produced, and during the rotation there is a retiring of the cutting edge from the cut surface. The idea of using a spring, as in the artificial leech, had occurred to me, but I thought the rotation might be effected with greater nicety and precision by the hand than if we used anything like a spring. In consequence of the retiring of the cutting edge, a certain pressure would have to be kept up to allow it to penetrate. I should be afraid that the pressure might cause it to go too far in and hit the lens.

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* Since the date of this communication, I have modified the operation by only penetrating with the trephine through three-fourths of the corneal tissue, and peeling off the circular portion to this depth with forceps and broad needle—afterwards, only perforating the remainder with a needle in the very centre, again and again at intervals as the aqueous re-accumulated—thus obviating the inconvenience of the anterior synechia above referred to; and this I regard as a further improvement of the method. I have thus had some excellent results and no failures.

There are other methods of opening the cone, which I should like to enumerate. I have practised doing so by a flap, and I think it is a very nice method. I learnt it from Mr. Bader. With an ordinary Graefe's knife I make the flap on one side of the cone, and then seizing the flap so made, I cut more or less away on the other side by a pair of scissors. In this way considerable precision of section may be given. Another method which has occurred to me is to have two little needles or cutting knives, very small, adapted to each other in a single stem, so that they can be placed at any distance, but may be always kept parallel. I should make with these a little incision in the vertical direction. Mr. Weiss has promised to make me such a knife, but it has not yet been made.

Another method that occurred to me is to have a pair of forceps, with, in each blade, two sharp points, so that one pair of forceps has four sharp points, which could be limited, so that the utmost expansion of the forceps might be governed by a scale. They would pierce through the cornea, and come together through it, and in that way, with a pair of scissors or knife, the portion seized might be cut off. The amount removed might thus be pretty accurately defined.

Then there is the actual cautery which Mr. Bader has practised. My attention has been much drawn to this subject by the results of Mr. Bader's most admirable operations. I have had some cauteries made of different sizes and shapes, so that the area destroyed may be accurately defined.

In passing from this subject, I may say for a moment, in conclusion, that these trephines of larger size I have used from the first period of their having been made, viz., in 1869, for the treatment of staphyloma, generally in children, following purulent ophthalmia; where a considerable bulbous staphyloma occurs, I have been gratified by the extreme harmlessness and painlessness of the treatment. The patient having been put under chloroform with a large trephine, an eighth of an inch in diameter, or even larger, a central portion is removed. In this case you push it well in. There is no lens to trouble ourselves about, or, if there be, we do not mind, and the part within the trephine is removed. Afterwards, there is no irritation. The child will not cry at all after the operation. In a week or two the aperture is closed up again. If, then, there be still a bulge, we can repeat the operation, taking away really a much larger portion, although the instrument is the same, because the external parts have become drawn towards the centre. Thus these cases may be treated with great simplicity, and I can answer for it that it is a very harmless proceeding, and satisfactory in its results. No vessels can be wounded which will give any trouble.

XXV.

DISCUSSION ON GLAUCOMA IN THE SECTION OF OPHTHALMOLOGY OF THE BRITISH MEDICAL ASSOCIATION MEETING HELD AT CAMBRIDGE, 1880.

'*British Medical Journal,*' 1880, *p.* 389.

The President, in bringing the discussion to a close, remarked upon the immense advance achieved through the researches—Anatomical, Physiological, and Pathological—which the glaucoma problem had been the means of eliciting during the last twenty years. We now looked upon the aqueous chambers of the eye, not only as a space within which the relative position of certain optical structures and their needful movements were provided for, but also as an arrangement securing a nearly equable elastic support for all the parts within the globe under varying nervous and vascular conditions. The aqueous humor seemed not to be a stationary fluid or quite a fixed quantity. It was being ever secreted, and ever in course of being removed, through the rim of the anterior chamber, from the receptacle which it occupied. It also probably removed, served for the more effectual nutrition of the neighbouring non-vascular vitreous body and lens. By it the intra-vascular and intra-ocular pressures were held in mutual harmony within certain limits, the limits of health. When this harmony was impaired by an arrest of the due escape of aqueous humor through Schlemm's canal, the intra-ocular tension rose, and the secondary evils of glaucoma followed. Most interesting questions had been propounded, and still lacked solution, as to how, under different circumstances, the balance of elasticity was lost; and especially how that adhesion of iris to cornea, and consequent mechanical closing up of the rim of the anterior chamber, was brought about, which in many, though not all, of the cases of established glaucoma, seemed to account for high tension. It appeared to be a matter of the greatest interest, and might have the most direct bearing on practice, that we should, if possible, understand the *rationale* of the glaucomatous process. He entirely agreed with Professor Donders, that the most exact anatomical account of the natural structures, and of the morbid deviations, was our first requirement—the *sine quâ non.* We still wanted also the detailed clinical histories of numerous cases, in connexion with the indispensable, exact, and true examination of the tissues concerned, for there were many anomalies waiting for explanation, and this to be satisfactory, must be a general and comprehensive one.

XXVI.

A CASE OF SEVERE SYMPATHETIC OPHTHALMIA COMPLETELY RECOVERED FROM.

By William Bowman, *F.R.S., in 'Transactions of the Ophthalmological Society of the United Kingdom,' Vol. III, pp.* 69 *to* 72.

On 12th October, 1868, Louisa Flowers, a healthy child of six years, fell while carrying a plate, which being broken, cut the forehead and eyelid slightly. The eye itself was not thought of. No medical man was called in for two weeks, there being no pain. My friend, Mr. R. W. Wilcox, of Aylesbury, then saw her, and found a horizontal cut through the cornea and ciliary region of the right eye, with the iris largely protruding. He removed this prolapse, but when, in a few days, the aqueous was restored, further prolapse occurred.

After three more weeks, viz., on the 17th November, Mr. Wilcox, not having seen her for a week, found the other, or left eye, inflamed, and sent her to me.

On the 18th, I found the wound bulging; there was moderate congestion of the globe, though the cornea and aqueous were clear, and the iris was nearly natural in aspect. Pupil small, motionless, drawn behind the cicatrix, –T1? V. = J20. The left eye was generally injected, with large vessels near the cornea; the anterior chamber was rather deep, the diameter of the pupil varied, under changes of light, between 4 and 6 mm., there being no synechia. –T1. V. = J16. I excised the wounded eye the same afternoon, and ordered continual exclusion of all light from the left.

The next day, the 19th, eighteen hours after the excision of the right, the child was evidently relieved and merry. Tn, and continued to be Tn on each of many following days.

On the 23rd, the conjunctiva and sclerotica were perfectly free from injection, but on slight exposure to light for purposes of examination, the ciliary vessels, especially below, became a little injected, and the eye watered. V. = J2. Atropine was now used regularly, but the pupil dilated only to a diameter of 4 mm., being slightly held to the lens by effusion.

On the 24th, pupil free, 7 mm. in diameter. Tn.

25th.—Pupil 9 mm. V. = J2.

28th.—Atropine having been intermitted pupil contracted to 4 mm. V. = J1. But there was rather more ciliary congestion, especially of the perforating anterior ciliary arteries. Atropine was now constantly used.

30th.—Ciliary region redder, especially along a circle about 3 mm. from the cornea, and the conjunctiva reddened generally, with lacrimation, when the eye was exposed to light. It was thought better not to test the vision during the ensuing weeks.

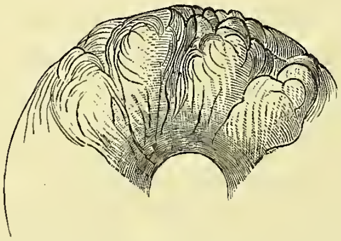
On December 2nd, the pupil was adherent at its lower edge, and the lower half of the cornea was finely dotted on its posterior surface.

3rd.—Less redness. Continue the atropine.

12th.—Till to-day injection has been lessening and Tn uniformly, but now more general redness, and –T1. Also more haze of cornea and chamber. Treatment: darkness and atropine (gr. ij—ʒj) more frequently.

21st.—Many synechiæ all round; pupil 4 mm. Tn.

24th.—Yesterday more injection without obvious cause; now lower half of the ciliary region injected, the chief redness being at a little distance from the cornea. The two lower perforating arteries dilated and tortuous (atropine gr. iv—ʒj).



29th.—For two days much better. The ciliary vessels much emptier, and now not very obvious.

January 4th, 1869.—Improving. Dull reflex by the ophthalmoscope. Iris thrown into plaits (*see* Fig.) Anterior chamber otherwise normal; aqueous clear; dots on the cornea less apparent. With $+\frac{1}{9}$ V. = J14.

14th.—Continued absence of vascularity. Only the two perforating ciliary arteries rather too full; corneal dots fainter. The iris is now, in all its circle, and from its great circumference, half way to the pupil, or rather more, thrown into folds bulging towards the anterior chamber, and showing accumulation of fluid behind it in closed pockets formed by partial uveal adhesions to the lens-capsule. Atropine gr. iv—ʒj, ter die.

21st—Improving.

27th.—Progressing slowly. With $+\frac{1}{9}$ V. = J6.

February 4th.—Sclerotica now nearly white, its vessels hardly seen. Sight said to be "much clearer."

11th.—The eye has reddened for some hours after violent exercise in running about the park, and, perhaps, some exposure to light.

25th.—Corneal specks less.

March 4th.—Cornea clearer. With $+\frac{1}{9}$ V. = J8.

11th.—Reflex still dull, but better than on January 4th. An irregular circle, 4 mm. diameter, of fine pigment dots on lens. Diameter of pupil, 5 mm.

April 1st.—Tn. No redness. Only a few fine brown dots on back of cornea. No puckering of the iris now. A faint circle of pigment on capsule within the line of the dilated pupil.

May 3rd.—With $+\frac{1}{9}$ V. = J4 at 5″. Iris in its normal plane; only the faintest remains of specks on cornea.

August 9th.—No spots on cornea, only a faint haze seen by lateral illumination. The iris flat, except at one spot below at the great circumference, which possibly escaped observation in April and May. Pupil dilated to 5·5 mm. Apparent uveal adhesions at its margin. Sclerotic and ciliary vessels are quite normal. With $+\frac{1}{9}$ V. = J2 at 5″. In May, had scarlatina, and eye became temporarily redder, but immediately yielded to atropine, which has been continued to the present time. Continue atropine once a fortnight.

November 24th.—Pupil under atropine dilates to 6·5 mm. Iris looks perfectly natural. No appearance of any synechia, and none of pigment on the lens. The fundus normal. Repeat atropine once a month.

May 18th, 1870.—Tn, pupil active. V. = J2 at 12″.

October 29th.—Eye seems well.

November 9th, 1872.—Eye reddens a little. Some myopia coming on. When corrected with $-\frac{1}{28}$V = J18 at 15′.

March 17th, 1873.—No redness. Pupil free and active. Artificial eye ordered. M. = $\frac{1}{20}$, and V. = J18, at 15′.

July 22nd, 1874.—Well. V. = J1 at 10″, and with $-\frac{1}{18}$ V. = J19, at 15′.

March 23rd, 1881.—Eye perfectly comfortable and well; pupil active. On the front of the lens, up to the anterior pole, chiefly on the lower and outer part, a very fine dusting of brown pigment, not in patches, could be seen by careful examination under lateral illumination, but not by transmitted light. V. = J1 at 10″, with $-\frac{1}{28}$ V. = J2 at 14″, and with $\frac{1}{9}$ V. = J18 at 15′. No astigmatism. Ordered $-\frac{1}{28}$ for reading, and $-\frac{1}{9}$ for distance, in reversible frame.

May 10*th*, 1883.

P.S.—1883, July 10th.—Mr. WILCOX replies to my inquiry :—"Eye in as good condition as one could wish. Iris healthy in appearance. Pupil round and free. After reading and doing fine needlework there is a feeling of fulness at the back of the eye, and that is the only complaint that I could induce her to make."

XXVII.

COLOUR-BLINDNESS (REMARKS). SECTION OF OPHTHALMOLOGY OF THE BRIT. MED. ASSOC. MEETING, AT CAMBRIDGE, 1880.

'*British Medical Journal,*' 1880, *p.* 389.

The President said: As the great subjects of Light and Colour are about to engage our attention, I may remind the meeting that the theatre in which it is our privilege to assemble, is that in which the Lucasian Professor is accustomed to unfold the discoveries of Newton and Young, and all the more recent advances in knowledge, so much of which the world owes to his own genius. I can assure Professor Stokes that we all highly appreciate the grace of his presence with us to-day. In Professor Donders we are proud to recognise the colleague who has more profoundly studied the colour sense, and those remarkable defective forms of it that we call colour-blindness, than any other living ophthalmologist. He has also, in his own country, been mainly instrumental in framing and causing to be adopted wise rules, generally applicable for the detection of colour-blindness, in relation to the exigencies of daily life. He has been good enough to bring over from Utrecht, for our inspection, the instrument which is on the table, lately devised by him for the more ready testing of colour-blindness, as well as the other illustrations on the wall. It will not, I suppose, be easy for any of us to feel completely master at the moment of all that will be set before us. The nature of our colour-perception is a very large field, presenting many profound problems. The mind would fain embrace in one view its objective and subjective, its physical and physiological aspects. Our knowledge of it too, is doubtless still far from complete. I may allude to one special difficulty which meets us. Our very words seem to fail us; for those we employ to denote the various colour sensations experienced in ordinary sight, are the same which colour-blind persons both hear us use, without their being able to attach them to our meaning, and themselves employ in a sense which we in turn, can only imperfectly realise. Hence confusions on one side and the other, perplexing the investigation and embarrassing the task of explanation. We are happy in having, in Professor Donders, an expositor of rare power—who well knows, moreover, how best to present the subject to us, as scientific men and practitioners. The *genius loci* should aid both himself and us to-day.

XXVIII.

SECTION OF OPHTHALMOLOGY—INAUGURAL ADDRESS BY THE PRESIDENT TO THE INTERNATIONAL MEDICAL CONGRESS.

By WILLIAM BOWMAN, *F.R.S.*, *in* ‘*Transactions of the International Medical Congress, Seventh Session,*’ *held in London* (*Assembled in the Meeting Room of the Royal Society*, *Burlington House*, *August*, 1881), *Vol. III*, *pp.* 1 *to* 7.

GENTLEMEN AND DEAR COLLEAGUES,

Many of those whom I have the happiness and honour of now addressing will be able to recall the proceedings of the Fourth International Congress of Ophthalmology when it met in London nine years ago.

Our branch of practice on that occasion stood in a sort of isolation, separate from the rest of the body medical, moving in an orbit of its own. In that isolation it had during many years set an example, which was in due time to be followed by the General International Medical Congresses, of which the seventh is now being held in our Metropolis. To-day we are obviously one among many members of the entire medical commonalty, and our work is admitted to be of the highest value, not only for its own sake, but for the beneficial influence which its aims and methods exercise over the whole field of Medicine.

In the brief interval since 1872, our President of that year, Professor DONDERS, has been called upon to occupy the still more honourable post of President of this General Congress at Amsterdam. Let us greet him here once again, now in both characters, with the respect and affection which are so much his due. We owe it to him that our calling has been much advanced and elevated by the unfolding of many new truths and the free presentation of them to us in lucid array, so that all men could turn them to account in the ordinary everyday round of practice, to the great benefit of ourselves and patients.

On the occasion to which allusion has been made it was the College of Physicians which offered us accommodation, that ancient English Corporation of the Sixteenth Century, which, at its original institution, comprised upon its rolls almost all that was greatest among us in medical learning and practice, and which now, with characteristic liberality, is doing its utmost, with our other brethren, to further the success of the present world-wide Convention.

It now happens, however, that our Ophthalmological Section of this Congress is domiciled otherwise, viz., in the room of an illustrious Society, the time-honoured representative among us of the whole range of natural knowledge, for the promotion of which it was laboriously founded: largely, we may reflect with pleasure, by the co-operation of men of our own profession.

The circumstance is quite accidental, but it may serve to remind us of the deep and necessary connexion of every Department of Medicine, our own in a marked degree, with the principles and subject matter of the Natural Sciences in general. Man's body and mind have relations with the whole universe, and thus far extend also the aspects of those relations with which the healing art is concerned: which we study in man's interest in order that we may understand how to modify or control them for his individual or general advantage.

As to these great modern International Congresses of the private men of various countries (of which it may perhaps be said that the present one is already proving itself the largest and most remarkable of any), this room may remind us how lofty, how noble have been the aims of some of the greatest intellects of the past, of whose achievements we find ourselves to be the fortunate inheritors. For it is Science itself, and nothing less, in the persons of a series of its eminent cultivators in many countries, working in an unselfish and open spirit, that has at length made such Congresses possible, and, in fact, has brought them about.

The Royal Society was founded, we may remember, about the time of the death of HARVEY, and in the near radiance of that Baconian light, of which the token was that it must be, not dry and barren, but fruitful and beneficent for the use of man's estate. And above me, in your view, is the bodily presentment of the greatest of the Society's Presidents—of NEWTON, from whose genius and character have radiated, for us and for all succeeding ages, the beams of a potent and almost divine influence.

Let me, for a passing moment, strike a chord that will wake an echo in every breast, and give expression to the trust, that in our deliberations we may be guided by the simplicity of his pure love of truth, and of truth only: as well as by its correlative, that modest self-estimate, that humility of mind, which in him was the mark of a deep consciousness of his own individual littleness, and almost helplessness in presence of the dark problems of the unknown. "I know not what I may appear to the world," he is reported to have said towards the close of his life, "but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble, or a prettier shell, than ordinary, whilst the great ocean of truth lay all undiscovered before me."

Let us now proceed to what lies more immediately to our hand. Those who have had the task of organising the arrangements for the present Congress, have been actuated chiefly by the desire that useful results should follow from it. With that view they have endeavoured to apportion the very short time at our disposal to the consideration of special subjects, carefully selected, such as seemed likely to be elucidated by the mutual exchange of thought between men of weight and experience coming together from distant places. They think themselves fortunate in having, in so many instances, secured the co-operation of distinguished masters who have, we have reason to believe, made special studies for their addresses, and whose words will be received, I am sure, with the respect to which they will be so well entitled.

In our own proper section of Ophthalmology, we shall have the advantage, on successive days, of directing our minds to the several important questions set down in our programme. The names of HORNER, SNELLEN, LEBER, ADOLF WEBER, and DE WECKE, assure us that the materials for deliberation will be ample, and competently presented to us. There are also additional communications by able men, bearing on the same matters, and these will be read in juxtaposition, previous to opening the debates. The high reputation of so many of our members raises our expectations as to the results.

As it is very desirable that a good record of our discussions should be preserved in our 'Transactions,' it is earnestly hoped that every member who may favour us with his opinions should be as clear and as terse in the expression of them as may be; and should, at latest, by the following morning, while the memory is still fresh give a copy of his remarks in writing to the Secretaries. As to this, facilities will be afforded, and failing this, the Secretaries cannot be responsible for the publication, as we have no authorised reporters.

To-morrow the first of the distinguished men whom I have just now named, will place before us a subject of great interest and importance, the "Antiseptic Method of Eye Surgery." I presume that no one nowadays will question the evils we are so familiar with in our practice, and which have so often marred the intention of well-devised operations skilfully performed, but where, as we hear it said, Nature has failed to do her part, to second the effort of the surgeon by a due process of repair. The study of the causes of such failures and of the means of obviating them, constitutes far the most brilliant page in the history of Modern Surgery; and in other sections of this Congress, while the name of LISTER will be applauded, the wide questions he has raised, and in raising has so often cleared up, will receive the full consideration they call for.

In the case of the organ of sight, specially constituted and in some respects screened from injury as it unquestionably is, there are reasons why the application of precautionary antiseptic measures, though the principle of them must still assert itself, should take a somewhat special form. Owing to the local structural conditions they may apparently be often more simple, though the possible need of the more elaborate of them should never be allowed to fall out of view.

The tears are a secretion as pure from extraneous particles as is the filtered air in the recesses of the lungs. They are poured out under cover, in the right place, in quantity suitable to the need; while the lids diffuse them over the conjunctival surface ere they escape by their proper channels. Their useful and multiple office is performed in a way so simple and so perfect, that no art, however skilful, could pretend to equal it. We should ponder well the deep marvels of adaptation of means to ends, and take heed that we do not hinder exquisite Nature by meddlesome or needless interference by the *nimia diligentia Chirurgorum*, but only lend it tender and judicious help by our dressings and our methods. We should always still be able to apply the words of our great poet, "The Art itself is Nature."

Three papers by Dr. **Reymond**, of Turin, Professor **Leber**, of Gottingen, and Dr. **Emmert**, of Berne, relating to this same subject, of antiseptic surgery, will be read before the discussion is proceeded with.

On Friday we propose to treat in our Section the deeply interesting, and I must add the very sad, subject of "Sympathetic Ophthalmitis," under the able guidance of Professor **Snellen**. This in all its aspects and stages is an affection peculiarly calculated to arrest attention. Though it has been extensively and very accurately studied, it yet remains very obscure. Even its anatomical conditions cannot be said to be fully explored; why it should occur is little understood. The explanation of the very remarkable phenomena manifested lies hidden for the present in unknown anatomical and physiological relations, and it is to experiments on the lower animals that we may look with the most probability for a clue to the enigma. Humanity will have reason to rejoice when this too-frequent cause of total blindness shall yield to a clearer insight into its nature, and to the consequent hoped-for discovery of the means of prevention or cure; for at present it brings life-long misery to many homes. Meanwhile experience suggests some general rules which may do something to ward off this terrible malady, or help us, in some instances, to control it, even now and then to check its progress temporarily, and perhaps permanently. The difficulty lies in the application of such rules, and to this point our discussions may, I think, very usefully be directed.

An important paper by Dr. **Brailey**, on "Pathological Changes in Sympathetic Ophthalmitis," and another by Dr. **Poncet**, of Cluny, on the "Histological Examination of an Eye Enucleated after Enervation," will be read in this connexion.

On Saturday, the main topic for us will be introduced by Professor **Leber**. It is one of a class which has recently been shown to have much wider relations than could have been imagined possible some few years ago, and which is certainly destined to attract more and more attention, not only from ourselves, but practitioners at large. The immortal invention of **Helmholtz**, by opening to the view of all instructed men the marvellous background of the transparent chambers of the eye, has gradually awakened inquiries on the part, first of oculists, and then of physicians, which even in their infancy have yielded results of rare and unexpected value. The changes visible by the ophthalmoscope will naturally be noted down, and their varieties and sequences determined, before the precise interpretation of them by exact structural examination, and their true pathological import, can be ascertained.

These only admit of being worked out slowly, as opportunities, often rare, give occasion. Our knowledge of the relation of those aspects of the fundus of the eyes to what is concurrently going on in the optic avenues, and in the several associated portions of the wondrously complex double brain and spine, must in a great measure lag behind. And we must be careful not to leave for a single moment the safe ground of exact observation, or suffer ourselves to be beguiled by the wish to make the new knowledge fit into the old, till all seems a delightfully complete system. Such vain imaginations are not in the true spirit of Science. Nevertheless, some broad and general facts already reward the clinical industry and acumen of several physicians, whose names are a sufficient pledge of the reliable character of their results. But I believe those who know the most will be the most ready to confess how rudimentary, at present, is our insight into this very important field of enquiry. Indeed, the study of the brain function (employing that term in its widest sense), and of the aberrations occurring in it that we call disease, remains still in its very infancy. It advances, however, with rapid strides, by the several parallel roads of human and comparative anatomy, experimental physiology and pathology, and of clinical observation, including morbid anatomy; and it cannot be long ere splendid conquests must be won for us in regions which have been so long shrouded in darkness, and so dense, that in our ignorance we have been hardly aware of their gloom. In connexion with this discussion a comprehensive paper by Dr. BOUCHUT will be laid before you.

Glaucoma, the other great subject to be brought before us, is of even more practical importance than sympathetic ophthalmitis, because of its far wider prevalence, and its equally fatal consequences to sight when uncontrolled. We shall consider it in two aspects. On Monday, on the initiative of Dr. ADOLF WEBER, and after hearing papers by Professor LAQUER, of Strasbourg, by Mr. PRIESTLEY SMITH, of Birmingham, and by Dr. ANGELUCCI, of Rome, all bearing on the anatomical and pathological basis of the subject, we shall discuss its nature and etiology; while on Tuesday the grand problem of its treatment, and chiefly its operative treatment, will undergo critical examination at the hands of one fully entitled to carry great weight with all of us, Dr. DE WECKER, whose experience is very extensive. His address will be followed, before the discussion, by communications from Mr. BADER and Dr. ABADIE.

It was ALBRECHT VON GRAEFE, as you well know, gentlemen—that bright spirit, whose too early death we have not yet ceased to mourn, for ourselves and for Science —who, at the same moment that he announced to the world the discovery of a remedy for glaucoma, also drew for us, for the first time, the grand outlines of the clinical history of the disease. His treatise will endure as the model work of a most fertile genius. In it he laid down the chief sub-divisions of the subject, and how far his remedy was likely to be applicable in each. This single paper constituted an epoch in our department of the medical art. It was read, but hardly discussed, at Brussels, at the Second International Congress of Ophthalmology, September, 1857.

Several of those now present were there. The impression produced among them was profound. But yet we are still, twenty-four years later, anxiously inquiring what is the essential nature of the glaucomatous process, and what is the best remedy to employ.

It is, indeed, quite true that since that time our clinical knowledge of glaucoma has been greatly extended, and its varieties and complications recorded with some approach to completeness. Extensive researches, anatomical, experimental, and other have also been undertaken to account for the remarkable train of phenomena we observe. Attempts have also been repeatedly made to explain the *modus operandi* of von Graefe's celebrated remedy, but as yet, it must be allowed, without entire success. The treatment by iridectomy, too, has been largely tried, sometimes with modifications and, on the whole, it has been admitted to be the best and most reliable. The time, the method, the conditions of applying it to the varieties of eye-tension have been in many particulars, though not with universal concurrence, defined and accepted.

But, as was perhaps inevitable, men asking themselves *how* iridectomy arrested the glaucomatous process, were now and then led to desire and to propose, and then to inculcate, other methods, having the same end in view, proceeding too often on some fancy or speculation, the validity of which experience has not sustained. Some of these methods, after obtaining a certain currency, have fallen into merited disfavour, while others remain more or less worthy of discussion, some, perhaps, of general adoption, under limitations to be yet laid down.

It would be quite foreign to my present purpose to pass any opinion on particular modes of operating. We hope on Monday to hear the great problem, the pathology of glaucoma, well handled by our distinguished colleague from Darmstadt, and on Tuesday to learn, and debate upon, the latest conclusions on its surgical treatment, announced by our eminent *confrère* from Paris.

Many contributions are furnished on other subjects than those to which I have hitherto adverted, and some of them bear upon a question of great and permanent importance, to which I would now ask your attention for a few moments.

The precision of our modern methods of determining the accuracy of sight, and of the sense of colour, has at length made it possible to urge with increasing earnestness, on authorities responsible for the lives of travellers, whether by land or sea, the necessity of enforcing adequate test-examinations, not only on candidates before engagement, but subsequently, at stated intervals, on all persons employed, where good sight is an essential qualification.

If this be important in regard to railway drivers, guards, and signalmen, it is even more so in the maritime service. On land, each Government is in a very direct manner held responsible to its own citizens, and accordingly much has been done of late years in several countries, though effectually I fear in very few, to institute strict periodical examinations under State authorization and control. As to these, perhaps, a very close uniformity through different countries is not so very necessary, however desirable. But it is a matter of common and urgent concern to all nations, that on the open seas, on coasts and in harbours, an uniform system should prevail, as to the due and sufficient and periodical testing of the sight of those who may be in a position either to give or to observe signals, on the prompt discrimination of which a multitude of precious lives may at any moment depend.

And I trust it may not be very long ere such an uniform system of tests as Science can now supply, and also the obligation to put them in force among their own subjects will be willingly accepted by all civilized States.

The present seems a favourable opportunity for coming to some conclusions, and for laying down some definite rules, which by their clear and practical character may be likely to meet with general acceptance, and for pressing these with some urgency on Governments throughout the world.

It is for your consideration, gentlemen, whether a committee of this section, the composition of which might be international, may not with advantage be appointed to deliberate on this grave subject, and to report to us before the Congress closes.

I entertain the confident hope that any recommendations emanating from such a source, bearing, as they would probably do, the impress of moderation and good sense, as well as of exact knowledge of the subject-matter, would everywhere meet with the most favourable attention of statesmen, and be admitted by them as carrying great weight.

I would suggest such a committee, with Professor DONDERS as chairman, if he would be so good as to undertake that office.

Gentlemen, we anticipate hard work within the narrow limits of our sittings. I trust we shall be able to assemble punctually, so as not to waste moments which can never be recalled.

One more remark. There will be, I fear, the unavoidable difficulty and source of confusion in our converse, arising through the want in some of us of familiar acquaintance with one or more of the languages in which others are giving expression to their views. It is but too certain that we have not yet a common tongue, however probable it may be that mankind are tending in that direction. Misapprehension of each other's meaning is not unlikely to occur, and, at any rate, both the expression and the recognition of ideas will be impeded.

To lessen as far as possible this drawback, great pains have been taken to prepare, in the three official languages of the Congress, a suitable abstract of every paper, and to place these abstracts in the hands of every member who may wish to acquaint himself beforehand with the authors' propositions.

Besides the volume of abstracts, comprising those of all the sections, a few separate copies of those proper to our own will be in our meeting-room, for the use of those who may not happen to have the volume at hand. These copies remain in the room.

The executive of the section have reason to thank the authors for the promptitude with which in most cases the abstracts have been furnished to our indefatigable and able secretaries, who have been at the pains of collating them. If any faults of translation or of printing should be discovered, they will doubtless be attributable to the pressure under which the laborious task has had to be accomplished.

And now, my dear friends and colleagues, let me say that if some difficulties of the kind just mentioned await many or most of you, how much must you find them enhanced by the circumstance, unfortunate for himself also, that your President is, to a great extent, ignorant of the languages, French or German, in which many of the most valuable communications will be addressed to you, and the speeches delivered. All my life long I have regretted the slightness of my acquaintance with those foreign tongues, which in the past, as in the present, have been, and are, the channels by which priceless discoveries have been announced to the world, as well, perhaps, as the media of keen, even burning, controversies, when men encounter each other in their search after truth. Thus, and from other causes appreciable enough to most of us as life advances, we are apt to fall relatively into the background, and to have to rest content in finding our pleasure rather in learning at second hand, and after some interval of time, what others have been happily accomplishing, than in hoping to establish for ourselves, or to maintain a forward place. But never till the present moment have I had so much cause to lament my many deficiencies, since now they must of necessity affect others even more than myself. I rely, however, with full confidence on your kindness and indulgence, otherwise I could never at all have ventured to undertake the honourable office of being your President at this great Congress.

XXIX.

INAUGURAL ADDRESS AT THE FIRST MEETING OF THE OPHTHALMOLOGICAL SOCIETY ON JUNE 23RD, 1880.

By William Bowman, *LL.D.*, *F.R.S.*, *President.*

‘*Transactions of Ophthalmological Society of the United Kingdom*,’ 1881, *Vol. I*, *pp.* 1 *to* 5.

Gentlemen,

In addressing to you a few opening words on this occasion—an interesting one on many accounts—let me first say what an honour I feel it to be that I have been asked to preside over this meeting.

Some few of my older colleagues will, no doubt, easily recall a time, much contrasting with the present, when even the word "ophthalmology" had hardly become current, when ophthalmic practice, though worthily represented, according to an older standard, by a small array of well-known and much-esteemed names, could only boast in this metropolis of two special institutions, and these but little countenanced, except by the public, who appreciated their benefits to the poor.

In that day our great medical corporations, our schools of medicine, and our general hospitals, assigned to ophthalmic practice no special service: they rather looked askance upon it, if they did not ignore it altogether. Nevertheless, the names of Farre, Saunders, Travers, Lawrence, Guthrie, Tyrrell, Dalrymple, of Mackenzie, Middlemore, and others, may remind us that honourable work was even then being accomplished, and the reputation of our country abroad sustained, by men, some of whom were great surgeons, while others restricted themselves to a narrower field.

That is certainly a marvellous change, which a single generation has witnessed, in the estimate men form of the assemblage of subjects now comprised under the name proposed for our young Society.

It is but thirty years since an illustrious physiologist and physicist, then young, gave us the *ophthalmoscope;* and the medical world was prompt to profit in a number of ways by this new means of research placed within its reach. There was, indeed, in those days a harvest, ripe for rapid in-gathering, in many, if not in most, of the departments of medicine, such as probably no previous epoch had offered to the ardent zeal of its young and fresh minds—a harvest of which we are still garnering the fruit.

On almost all sides there was at that period swift and splendid progress—in the methods, even more than in the immediate results—of work. The microscope had disclosed many hidden secrets of the tissues: the several sciences, handmaids of medicine, had opened out various vistas of striking interest, leading directly to the contemplation of questions till then undreamed of, but now forcing themselves forward for solution. The clinical domain, too, cultivated with an ardour corresponding to the stimulus communicated to it, was responding with a rich return in practice. A truer insight into the nature of disease, and into the ways of observing and detecting it, was everywhere attended by simpler and more refined conceptions as to the best methods of averting it, or of dealing with it, either by letting it alone, or by interposing with remedies.

Honour to those men who have been foremost in discerning the true lines of progress, and in pursuing them for our common benefit and profit. Benefactors of mankind, to be one day recognised by all! In whatever country or language their conquests have been won, these are the men who connect us together by an indissoluble bond, who do us abiding honour: who show the healing art, however parcelled out, to be *one art,* which should admit no rivalries within itself, no contentions for rank or credit, except those which may establish, under the stamp of time, how much each man, or each department, may have contributed to develop and advance the whole.

I need not tell you, gentlemen, that that particular portion of the medical art, with which we ourselves are concerned, has grown in recent years to be so large, and of such copious and diverse promise, as to present itself already under some natural sub-divisions, very suitable for separate and almost independent study, fit to be advantageously approached from somewhat different sides, by somewhat distinct methods, and with somewhat varied aims. Problems, numerous and complicated, invite us, in the pursuit of which all the acumen, all the industry that the ablest of us can devote to them, may find room for exercise.

We must all rejoice—all interested in the progress of sound medicine must rejoice—at thus finding that new departments of work, drawing men on to a special study, by which alone the higher order of results can be attained, are thus starting into being.

May I say, on the part of older men, that we look eagerly and hopefully towards the younger to instruct us in new paths to correct our many inadvertences and errors, and to be our pioneers towards a brighter future.

I think it altogether superfluous to enumerate in your presence, gentlemen, the reasons which must have weighed with you to induce you to meet here this evening to inaugurate our Ophthalmological Society. The motives of a general kind are obvious enough, and are such as, under similar circumstances, have actuated the most enlightened men in other communities. Those that are local, and peculiar to the forms and framework of our country's professional organization, are too trite and familiar to need to be recounted. Your presence here represents them eloquently, and I should but weaken them by many words.

But I may not be wrong in reading to you, almost verbatim, an extract from the letter which was circulated amongst us in February: "In considering the best means," it is there said, "for fostering work, encouraging discussion, and facilitating publication in ophthalmology, it must not be forgotten that communications in this department are made every year to the general medical societies, and that a special Ophthalmological Society might be thought by some to be less useful, and might meet with less support, than the alternative of a special section of some one of the older societies. This alternative would, it is believed, have fewer advantages than the plan now proposed; moreover, it was, we understand, mooted some years ago without result. It is felt that the sole objection to a separate special society is that it might tend to encourage narrowness and exclusiveness of work. But, on the other hand, a society representing a subject which, like ophthalmology, is closely connected with almost every branch of medicine and surgery, may hope, by numbering amongst its members those who work at ophthalmic subjects from many different points of view, to avoid degenerating into a mere society of oculists."

I am truly glad to see here to-night several physicians and surgeons who are very competent oculists, though not called by that name, some who have greatly advanced the knowledge of ophthalmology in its more recondite regions, and who have been able to do this the more, for the very reason that their minds have been directed into novel lines of observation or research by considerations drawn from without, and whose largeness and originality of view have thus reflected a lustre on ophthalmology, not unsuitable to it, but which it could hardly have won for itself, had it been pursued only within its own limits. I feel that in the presence and in the active co-operation of such colleagues this Society will find much of its strength. I hope we shall always, by such associations, be guarded against narrow views, against aims and purposes not worthy of us. And those who may not soar so high nor embrace so wide a scope, may console themselves with the reflection, that even some small and sequestered corner of a subject, if but honestly, diligently, acutely investigated, may yield to them perchance a discovery, or a clue to one, which may make men think more correctly respecting some old well-worn doctrine, and thus advance them a little nearer towards the light.

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But we must not forget (perhaps we are in little danger of forgetting)—nay, we must in justice to our subject and to our brethren even insist, that the range of ophthalmology is itself so spacious, without any overpassing of its strict limits, and its nature is such, that, among all the sub-divisions of our art, it may claim to be that one which the most abundantly and clearly exemplifies those means and methods, which all students should strive to master and employ, if they would make and maintain themselves worthy members of the great community of practitioners of medicine.

Gentlemen, I may perhaps have detained you too long. I have only now to assure you how heartily I desire that success may crown our present design, and I invite you to proceed with the work of constituting our Ophthalmological Society.

XXX.

ADDRESS BY THE PRESIDENT AT THE FIRST ANNUAL MEETING OF THE OPHTHALMOLOGICAL SOCIETY, JULY 6TH, 1881.

'*Transactions of Ophthalmological Society of the United Kingdom*,' 1881,
Vol. I, pp. 225 *to* 229.

GENTLEMEN,

At this, the first anniversary of our Society, a few remarks will not be out of place as to the history of the Society during its first year.

Early in 1880 a circular suggesting the formation of an Ophthalmological Society was sent by a few gentlemen in London to a large number of the leading ophthalmic surgeons and others likely to be interested, in the three kingdoms.

Early in June upwards of fifty adhesions had been obtained, and on the 23rd of that month, at a preliminary meeting, convened by previous notice, the Society was constituted. This meeting was attended by twenty-eight persons, of whom four came from distant parts of the country.

At this meeting thirteen other gentlemen, in addition to the first list of fifty, were incorporated among the original members.

The necessary rules of the Society were shortly afterwards drawn up by a council selected at the above meeting, and were adopted at the first ordinary meeting on the 28th of October, when it was also further agreed to admit to the list of original members sixty-three gentlemen who had in the interval expressed their wish to join the Society.

I have been very happy to find that during the session new members have continued to join us, and at the present time our numbers are 141 ordinary members, besides four honorary members, whose association with ourselves we think has done us honour, while showing also our sympathy with those of other countries engaged in a like pursuit.

The Society is to be congratulated not only on the very considerable number of its members, but on the wide range of professional interest and worth which they may be taken to represent. This appears from the fact that of our 141 members nine are Scotch, seven Irish, forty-three from English provincial centres, five from our Colonies and Egypt, whilst among them are fifty physicians and others not engaged, or only partly engaged, in ophthalmic practice properly so called.

Accommodated in the excellent rooms of the Medical Society we have held eight meetings during the year, six of which were fixed under the rules, and two have been extraordinary ones, viz., one for an important adjourned discussion on "Optic Neuritis," and one for receiving the Report of the Committee on "Colour-Blindness."

The outlay incurred has been necessarily rather heavy in this the opening year, owing to sundry expenses which are not expected to recur, and the Council hopes that with the increase in the number of members, which it is only fair to anticipate, the funds available for publication of papers will next year be larger.

The Society will feel an interest in hearing how the meetings have been attended. The average number of persons present has been thirty-two, exclusive of visitors introduced, and in this return the present meeting is not reckoned. Of course the large majority have been town members, but we have invariably been favoured by the attendance of several from considerable distances. An encouraging activity has been displayed in bringing papers, living cases, and morbid specimens before the Society, the total number of communications made, including those of this evening, being fifty-four.

Very early in the session it became evident that an important feature at our meetings would be the exhibition of living specimens of disease, and that often only very short previous notice of such cases could be given. Some arrangement became necessary to allow of their description and adequate exhibition without derangement of the more formal papers which had been announced. The plan of showing specimens by card, which has for some time been in use at the Pathological Society, has been accordingly adopted, and extended, so as to include living specimens; and a printed card of bye-laws regulating these and other matters having been drawn up by the Council, was sent during the session to every member.

In accordance with these regulations I may remind you that all *living* specimens *must*, and that pathological specimens, drawings, instruments, &c., *may* now be described on a card provided for the purpose, obtainable from Mr. POOLE at these rooms. Such written description is taken as equivalent to an oral communication of the case, but the exhibitor or his representative is required to be present, and prepared to read the case more fully or to supply further information if called upon. The *title* of the case will of course always be announced from the chair, with the agenda for the evening. It is also arranged that any discussions or further descriptions belonging to this class of communications must be limited to the first half hour of the meeting, and that in the half hour so appropriated no speaker shall occupy more than five minutes.

I cannot dismiss the work done during the session without especially referring to the important discussion "On the Relation of Optic Neuritis to Intra-cranial Disease," introduced with so wide and accurate a mastery of the subject by

Dr. Hughlings Jackson, one of our members, which occupied two meetings: and secondly, to the "Report of the Committee on Colour-Blindness and other Visual Defects in relation to the Signalling Service by Sea and Land." This report, drawn up by the indefatigable Secretary to the Committee, Dr. Brailey, who bore the principal part in the investigations upon which it is based, contains, besides other matter, the results of the examination of 18,088 persons at different periods of life, and of various social grades: the general result being that 4·76 per cent. of males in our population are colour-blind, and 0·4 per cent. of the females; this defect in the latter being also only slight in degree.

I advert with special pleasure to the fact that a large and important part of the total communications received by the Society has come, as was hoped and anticipated, from members of our body not engaged in ophthalmic practice, and particularly from physicians largely concerned with diseases of the nervous system. It is earnestly hoped that this feature will continue to be strongly marked in the Society's work, and that the Society may aid in maintaining the high standard which medical ophthalmoscopy may fairly claim to have reached in this country, and in preventing the isolation of oculists proper from other practitioners. In this respect, the example we present may be worthy of being followed in some other collateral provinces of our common and beneficent life-work. The success so far achieved, justifies the belief that the want of opportunities such as are here afforded has been widely felt both by specialists and others.

The Council, which has met before each meeting of the Society, and has also held several special meetings for various purposes, has made arrangements for the publication of the first volume of the 'Transactions' in October. I must warmly express my sense of the great obligations we are under to our able Honorary Secretaries, not only for their trouble in editing the 'Transactions,' but for the unremitting attention they have given to the other duties attached to their office, on the punctual performance of which so much of the success of our opening year has depended.

There is one further matter of special interest to us at this time, which I ought not to pass over. I allude to the approaching seventh meeting of the International Medical Congress in London, from the 2nd to the 9th of August. In this ophthalmology will be represented in a separate section, one of sixteen. In regard to this section, I am already able to announce that a large number of eminent foreign ophthalmologists are expected to be present, and that a good array of papers, about forty in number, have been announced. These range over a large number of subjects interesting to us, some of which subjects were previously agreed upon as being suitable for special treatment before the Congress. I need scarcely express the hope that the meetings will be well attended by the members of the Ophthalmological Society. They will be held in the rooms of the Royal Society, kindly lent to the Congress for the occasion.

XXXI.

INTRODUCTORY ADDRESS AT THE OPENING MEETING OF THE OPHTHALMOLOGICAL SOCIETY OF THE SESSION 1881-2, OCTOBER 13TH, 1881.

By W. Bowman, *LL.D.*, *F.R.S.*, *President.*

'*Transactions of the Ophthalmological Society of the United Kingdom*,' 1882,
Vol. II, *pp.* 1 *to* 3.

In opening the present session I must refer, however briefly, to the assembly of the International Medical Congress here in London in the early days of August, when more than 3,000 medical men met, from almost every part of the civilised world, to communicate and to receive knowledge, to discuss questions most nearly interesting them, and to become personally known to each other. I alluded at the close of our last session to this great meeting, then in prospect. In the working of every one of its sixteen sections, the Congress proved, I believe, eminently successful. In that of ophthalmology, we were honoured by the presence of many men whose names and character and scientific labours were more or less familiar to us, and the several important subjects brought before us and debated will be found, I think, to have been advanced and elucidated, to the great advantage of all the cultivators of our Science, and of those to whom we minister.

It would be out of place on the present occasion to do more than mention the five principal topics introduced in the ophthalmological section in the most able manner by men of eminence from abroad. They were as follows:—"The Antiseptic Method in Ocular Surgery," by Professor Horner, of Zurich; "The Nature of Sympathetic Ophthalmia, and the Mode of its Transmission," by Professor Snellen, of Utrecht; "The Relation between Optic Neuritis and Intra-cranial Disease," by Professor Leber, of Gottingen; "The Pathological Changes preceding and causing Glaucoma," by Dr. Adolph Weber, of Darmstadt; "The Operations to be Employed in the various forms of Glaucoma," by Dr. De Wecker, of Paris. For myself I must express the delight with which I welcomed these and many other most valuable contributions, and my gratitude for the whole result.

This Society has almost from its origin manifested its interest in the subject of colour-blindness, both in its philosophical and practical aspects, and in the course of last session a committee named by it out of its members laboured hard to ascertain, with some approach to accuracy, the facts relating to it among our own population, and their report is of permanent value. It is fitting, therefore, here to recall an act of the Congress, taken on the initiative of the ophthalmological section, which it is hoped will be of much real utility as an aid to legislation in this and other countries, as time and opportunities may allow, and serve as a common basis, with international concert, in that direction in which we had already been endeavouring to influence opinion.

Under the presidency of Professor Donders, a representative committee prepared articles as to "Tests of Sight Suitable to be Enforced in the Case of Signallers and Look-out Men, and other Persons, by Land or Sea, with Suggestions as to International Arrangements for a Uniform System of Maritime, Coast, and Harbour Signalling, with a view to the Safety of Life and Property," followed by explanatory remarks under the several articles. These, having been adopted by the Congress, have been forwarded to the Foreign Office, with a request that they may be favourably considered and communicated to the various Governments. A copy has also been sent to the First Lord of the Admiralty and to the President of the Board of Trade. A copy is on the table.

The other general act of the Congress was one of hardly less interest to our branch of the profession than to others, and, indeed, to the whole human family. I trust it may have its due weight in modifying the public sentiments, and in enlightening the minds of our political men on a subject with the bases of which they have been but imperfectly acquainted, the result of this want of insight having been that they have consented too hastily to legislation, which has already proved lamentably obstructive to our countrymen, laudably and nobly desirous of advancing medical knowledge in its most fundamental principles. The resolution adopted by the Congress (there being no dissentients) was as follows :—

"That this Congress records its conviction that experiments on living animals have proved of the utmost service to medicine in the past, and are indispensable to its future progress. That, accordingly, while strongly deprecating the infliction of unnecessary pain, it is of opinion, alike in the interests of man and of animals, that it is not desirable to restrict competent persons in the performance of such experiments."

I am happy to be able to announce that through the zealous co-operation of the officers of the several sections, under the energetic editorship of Sir William McCormac, the Honorary Secretary-General, there is a good prospect of the appearance of the 'Transactions' of this great Congress in three volumes, comprising over 2,000 pages and some illustrations, before the close of the year.

And now, gentlemen, to return to the more limited and immediate sphere of our own Society, I have the pleasure of saying that our first annual volume of 'Transactions,' edited by our excellent and laborious secretaries, is published to-day, and a copy is on the table.

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XXXII.

PRESIDENT'S ADDRESS AT THE THIRD ANNUAL GENERAL MEETING OF THE OPHTHALMOLOGICAL SOCIETY, JULY 6TH, 1883.

By William Bowman, *LL.D.*, *F.R.S.*

'*Transactions of the Ophthalmological Society*,' 1883, *Vol. III*, *pp.* 30 *and* 305.

The Society has passed through its third session, and is in all respects in a satisfactory state. The expenses during the present session have not been heavy, and, as the Treasurer's Report will show, we have a good balance in hand.

During the session twenty-two new members have been elected, fourteen of these being Metropolitan, three from colonies or dependencies, and five non-Metropolitan, but within the kingdom. There have been two withdrawals, and the Society has lost two members by death, viz., Mr. Critchett and Mr. R. W. Lyell. The Society has already given expression to its sense of the great loss it has sustained in the demise last autumn of our eminent and esteemed colleague, Mr. Critchett, and this is not the time to enlarge upon it. Mr. Lyell was a young surgeon and ophthalmologist of brilliant attainments and great promise, and his early death has deprived the Society of a member whom we had hoped would add much to the value of its records.

Our gain *in number* during the session is therefore eighteen; and our total number of ordinary members is now 176.

The number of meetings has been the same as last year, viz., eight; seven of these being fixed, and one an extra meeting for the adjourned discussion on "Eye Symptoms in Spinal Disease."

Owing to the building operations which have been going on nearly all the session, several of the meetings, especially in the cold weather, were held in considerable discomfort, despite the best efforts of the officials of the Medical Society, to whom we are always much indebted. We may, therefore, I think, feel well satisfied that the average attendance of members has been very nearly as good as in the two previous sessions.

The time of the Society has at every meeting, without exception, been very fully occupied with communications and the discussions arising out of them. The total number of communications made this session is slightly less than last session, being sixty-six instead of seventy-one; we have, however, had several papers of much scientific value; and there have also been several communications of considerable pathological and clinical importance. The exhibition of living specimens has been much hampered by the state of the premises, but this important feature of our meetings will no doubt again assume larger proportions in future sessions.

The special subject opened by Dr. Gowers at the June meeting gave rise to a fair discussion, and to the contribution of a considerable mass of facts. This discussion is of much value as it stands, but its greatest use will (as in similar instances before) doubtless lie in the stimulus it will give to more exact clinical and pathological research in regard to certain specified points and problems.

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